June 1970

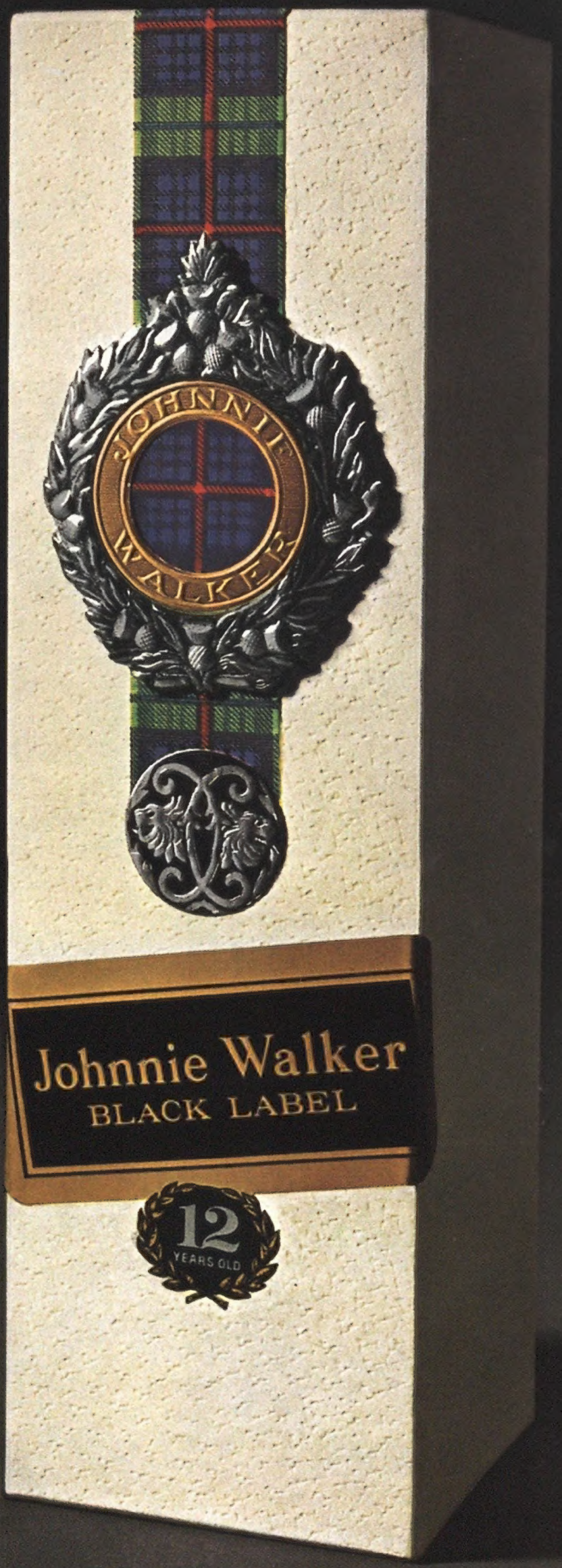
Smithsonian

Dawn of the air age

An adaptation introduced by Wally Schirra

Original Wright plane at Smithsonian

PRICES MAY VARY ACCORDING TO STATE AND LOCAL TAXES. 12 YEAR OLD BLENDED SCOTCH WHISKY. 86.8 PROOF. BOTTLED IN SCOTLAND. IMPORTED BY SOMERSET IMPORTERS, LTD., N.Y., N.Y.



It costs a lot, but so did you.

Scotch for Father's Day. About $10.

June 1970

Smithsonian

Volume 1, Number 3

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Cover Lee Boltin; 4-13 Mark Kauffman except map by Beveridge & Associates; 14 Julian Wasser; 14, 15 George J. Ceolla; 16 Julian Wasser; 16, 17 Jon Brenneis; 17 Jon Brenneis; 18 Ken Wittenberg; 18, 19 Ken Wittenberg, 19 Chris Knight, Frank Zagarino, Mac Shaffer; 20 top George Knight, Heinz Kluetmeier; 21 George Knight; 22-27 Lee Balterman; 28-31 Smithsonian Institution; 34-41 William K. Sacco; 42, 43 top Leo L. Anderson, Tom Warner, Hylton Warner & Co. Ltd., Cardiff, U.K.; 44, 45 Tom Warner; 46-49 Lee Boltin; 50 © by the California Institute of Technology and Carnegie Institution of Washington, photograph from the Hale Observatory; 52 top from *Science and Civilisation in China*, (Cambridge, 1959), William C. Miller; 54-55 Cornell University, 57 Hong-Yee Chiu, Roger Lynds and Stephen P. Maran; 59-60 Yoichi Okamoto; 61 Bob Yellin; 65 Smithsonian Institution

Smithsonian is published monthly by
the Smithsonian Associates,
900 Jefferson Drive, Washington, D.C. 20560.
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Reproduction in whole or in part without permission is prohibited. Subscription price $10 a year in U.S. and possessions, $11.50 elsewhere.
Second class postage paid at Washington, D.C.
Editorial offices at Arts and Industries Building,
900 Jefferson Drive, Washington, D.C. 20560.
Advertising and circulation offices
at 420 Lexington Ave., New York, New York 10017.
Please address all subscription correspondence and change of address information
to P.O. Box 404, Flushing, New York, 11378.

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Letters to the Editor

The first issue—yes

Dear Sir: Over a lifetime of subscribing at intervals to "new" magazines or journals that promised to be interesting, informative, entertaining or whatever, this is the first time I was ever truly able to say the product exceeds the expectations.

VIRGINIA JOHNSON
Clinical Psychologist
Los Angeles, California

Dear Sir: I have joined the Smithsonian National Associates and I wish to congratulate you and your staff for the excellence of the April issue.

THEODORE C. KAHN
Head of Department of
Behavioral Science
Southern Colorado State College
Pueblo, Colorado

Dear Sir: Congratulations! Volume 1, Number 1 sets a standard of excellence that portends remarkable success.

B.J. LUBEROFF, Ph.D.
Editor, *Chemical Technology*
Summit, New Jersey

Dear Sir: I look forward to a long, happy and informative association between us.

EVERETT C. SWEET
Stratford, Connecticut

Dear Sir: Congratulations on Volume 1, Number 1 of SMITHSONIAN. It is a handsome job.

J.M. MOULTON
Chairman, Biology Department
Bowdoin College
Brunswick, Maine

Dear Sir: It was pure joy for me from cover to cover—and I cannot recall another magazine that affects me that way.

MRS. FRANK J. BLACK
Atlanta, Georgia

Dear Sir: As a librarian and a concerned citizen, I commend you on your articles on ecology in your first issue.

These articles set good examples of the original assertion of Mr. Smithson on the best way to view knowledge: "Every portion throws light on all the others."

If this is an example of issues to come, I would be more than happy to call it to the attention of the class of Ecology at College of San Mateo and of the other librarians in the area.

LYNN MACKIN
San Mateo, California

Dear Sir: The first issue of SMITHSONIAN is simply great. For 30 years I have hoped for just such a publication. The René Dubos article alone is worth the yearly subscription. The only trouble—I read the magazine in one sitting and now must wait a month for the next issue.

MRS. MARGARET S. HESLEP
Silver Spring, Maryland

Dear Sir: Your writers are impressive, Dubos particularly. He is used as a reference by college students here, even in the anthropology department. Your first issue seems to be a well-balanced blend of professional writing, popular appeal and scholarly accuracy. How about some more articles on the Institution itself?

BARBARA E. EDGE
Public Library
Los Angeles, California

There will be many articles on the Institution itself, although SMITHSONIAN *will also be dealing with what the Institution is or might be interested in.* Ed.

The issue, no . . .

Dear Sir: It's terrible.

D.J. HEADLAND
San Jose, California

Dear Sir: I am informed that the Smithsonian Institution has received a fossilized impression of a Stone-age body discovered in Spain. One of my reasons for becoming a member of the Smithsonian National Associates is because I thought SMITHSONIAN would present articles about this. Now I find upon reading the magazine that it is really on the level of a junior high school student.

ENRIQUE FLORES
New York City

The cast is at the Smithsonian and being prepared for display. We plan to carry an article when it is ready. Ed.

Torn copies

Dear Sir: I received yesterday, my first issue of SMITHSONIAN. The magazine is all that you said it would be. It is interesting, stimulating, varied and very well written. Moreover, I like the clean, uncluttered open format. I like its readable-sized print and its generous margins for those of us who like to make marginal notes and bind magazines for future reference.

What I do not like about the magazine is that it came with just a mailing label. The cover is rain spotted, frayed, scraped, and with some torn edges.

BERNARD TUROV
Oceanside, New York

A number of readers have made the same complaint as Mr. Turov, and justly. Starting with last month's issue all copies are being wrapped. Ed.

'Crown-of-thorns'

Dear Sir: I greatly appreciated the first number of SMITHSONIAN. It may interest you that a recent issue of the American Society for Oceanography newsletter offers, quite in contrast to the usual items found on *Acanthaster planci,* the thesis of William A. Newman that the starfish may not be such villains. Here is certainly a case in which all the facts are not yet in.

W. CLARK CHAMBERLAIN
Presbyterian Theological Seminary
Austin, Texas

As SMITHSONIAN *said, the proliferation of* Acanthaster *is still a mystery.* Ed.

Dear Sir: The first issue! *Fantastic,* that is the only word I can think of. Your

"Coral killer puzzles science" was a most interesting and informative article that brought my attention to another menace of which I was unaware.

R.D. Brown, Ph.D.
Norfolk, Virginia

The advertisements

Dear Sir: The first number of Smithsonian has enormous appeal. My heart warms to its broadness of scope and fullness of illustration—and my mind to the caliber of the text. The overall quality, however, is diminished. Although solicitation of advertisements may be requisite, the dispersal throughout the publication of these full-color irrelevancies creates visual conflict and is an unwelcome distraction.

Mrs. A.I. Aronoff
Cincinnati, Ohio

Dear Sir: May I compliment you on the contents of the first issue of Smithsonian? However, I wish to protest most emphatically the cluttering up of the text and its magnificent illustrations with interpolated advertising pages.

Ernst C. Krohn
St. Louis, Missouri

Dear Sir: Congratulations, *a great start.* Just enjoyed René Dubos—a wise selection for the kickoff. He is so wonderful! And Robert Osborn—how good can you get. Very happy the format prevents a paper from being continued on page 3, 48, 59. Please continue to keep a given story in a separate section and not continue it all over the magazine. Keep up the good work.

Keith O. Karren
Salt Lake City, Utah

Naturally, Smithsonian *agrees with Mr. Karren. Mrs. Aronoff and Mr. Krohn might notice that an advertisement never cuts into the flow of an article. The ads were carefully placed to separate the individual items.* Ed.

Dear Sir: I express both my delight and concern with your magazine. You have produced a product that addresses itself to the most important problem of the day. You have produced a scholarly and informative journal, in an area for which all-too-few satisfactory writings exist. The presence of advertisements for some of the major polluters of our environment unfortunately detracts greatly from the force and effectiveness of your efforts.

Charles E. Aylworth
Louisville, Kentucky

Dear Sir: Rather than comment on the excellent and timely selection of articles, I wish to express appreciation for advertisements which reflect the heightened awareness that is necessary in order for us to meet the challenge of saving the environment. So much shouting is done against business and industry that I should like my quiet voice heard in appreciation of their concern.

Jeff M. Valentine
San Pedro, California

Dear Sir: The variety of articles looks quite interesting. However, I was disappointed to encounter a whiskey ad.

Robert W. Gibson
Auburn, Alabama

Smithsonian *accepts ads from corporations which are doing something about improving the environment. As to liquor ads, the United States tried Prohibition and then rejected it. There is no evidence that liquor* per se *is harmful, only the overuse of it.* Ed.

Black Studies

Dear Sir: I do not care to be exposed to the garbage contained in your article on Black Studies. There is enough polarization of the races already.

Thomas F. Koester jr.
Mount Pleasant, South Carolina

Ceylon elephants

Dear Sir: We're delighted with the new Smithsonian. My husband took our copy to his office and passed it around—resulting in a well-worn copy. Because of John Eisenberg's article on breeding elephants in captivity in Ceylon, I thought you might consider the elephant breeding going on in the Portland zoo.

Mrs. L.E. Holmgren
Portland, Oregon

Dr. Eisenberg and Smithsonian *were aware of your zoo. It was just that Ceylon hadn't caught up to Portland.* Ed.

Dear Sir: Just received my first issue of Smithsonian. Beautiful. But was it necessary to show on the cover of your first issue *chained* elephants instead of free, wild ones?

Carlos G. Munoz
New York City

There is no problem with wild elephants' breeding. The chains existed so the animals could be traced when they were allowed to go into the forest. Ed.

Dear Sir: Congratulations on Volume 1, Number 1. The new baby shows great promise! The René Dubos and Russell Lynes articles are excellent and "Coral killer" quite interesting. But I hope you do not make a practice of pictorial expurgation as in the illustrations accompanying the elephant article. To show elephants courting *preparatory* to mating, and a male elephant at work *after* copulation, and to omit the act of mating—when breeding is the very theme of the report—strikes me as downright prissy.

Marie Coleman Nelson
Smithtown, New York

The elephants were allowed to wander to the woods for the act of mating. Experimenters tried not to disturb them. Privacy is a privilege of humans too, except possibly in underground movies. Ed.

Experimental school

Dear Sir: Regarding the photograph at the top of page 57 in the article on perceptual education: The caption states that the children are viewing a scene from Philadelphia. The scene pictured is taken from the south side of 42nd Street in New York City. The intersection shown is 42nd Street and Fifth Avenue.

Aside from this obvious error I think your magazine is great. Keep up the good work and interesting articles.

Frederick Rotgers
Nashville, Tennessee

Mr. Rotgers and other readers are correct in spotting the error. The scene is *New York City.* Ed.

Dr. Calhoun's satanic world

Dear Sir: Our family is delighted with the diversity of the first issue and I was especially interested in Dr. Calhoun's experiments on overpopulation. My only regret was that the end came so soon.

Colleen K. Stockham
Alexandria, Virginia

As the Everglades was and could be again: In the Big Cypress Swamp drought four years ago, the empty tubs and skeleton of a cow (above) are mute evidence of the fate of both domestic and wild life. The rancher on leased land nearby could not save his cattle any more than the rangers could the deer.

As the Everglades should be: The deer, leaping through wet marshland, was photographed a few weeks ago not more than a mile away from the former drought area. Currently, however, the water is polluted and there is somewhat too much of it.

Photographs by Mark Kauffman

By Marquis Childs

The Everglades in era of reprieve, but concern remains

A new awareness may help to preserve one of America's national treasures, an almost mythical land of exotic creatures

From the ranger's small plane the landscape has the look of one of those medieval maps of heaven and hell. To the east like a wall of lowering thunderclouds is the skyline of Miami and Miami Beach. Seen through a haze of smog this instant human hive is the creation of man—not nature. To the south as we turn is the great shining sea of saw grass, the jutting hammocks of mahogany and live oak, this world of the remote past that seems almost mythical in that it exists at all, still relatively untouched by the blight fallen on a once lush and lovely land. Below us is a flock of wood ibis, their great white wings black-tipped. They rise and wheel and come to rest, startling against the shimmer of the saw grass in the late afternoon sun.

It is a myth, if you will, this preserve, the Everglades National Park, where miraculously man, the invader, the destroyer, has been held at a little distance. Within its 1.4 million acres, the third largest national park, are many of the birds, beasts and water creatures on the roster of vanishing species. Inherent in the concept of the Park Service is a paradox that is particularly evident in the Everglades. The natural environment is to be protected and preserved, and, at the same time, the public is to be given the greatest possible access to the surviving wilderness. As the flood of

The author, a noted journalist and columnist, is chief correspondent in the Washington bureau of the St. Louis Post-Dispatch. *The latest of his 14 books is* A Taint of Innocence.

visitors increases to well over a million a year this often seems a contradictory and even an impossible directive. The small Park ranger staff must be tour guides and traffic controllers along the macadam roads built into the Park at the same time that they are naturalists and protectors of the rare and threatened species in their charge.

How real the threat was, how persistent it continues to be, the recent controversy over the jetport made all too clear. The Dade County Port Authority acquired 39 square miles of land in the Big Cypress Swamp about six miles above the northern boundary of the Park. It was designed to be one of the two or three greatest international airports in the world, accommodating the supersonic transport and, in the first stage, relieving the dangerously overcrowded Miami International Airport. Eventually a city of a million or more would grow up around this great traffic center. For the land speculators it was a design to get rich quick, an added fillip to the speculative boom on both the Atlantic and Gulf coasts. Immediately after the land for the jetport was acquired an east-west jet training strip was put in at a total cost of $13 million. The roar of the bulldozer was heard throughout the land.

Then the conservationists went into action. The moment was propitious since at long last a wider public and not just a few fanatical true believers had come to appreciate how swiftly the last of the American heritage was being destroyed. Men such as Joseph Browder, then southeastern representative for the National Audubon Society, worked night and day gene-

Smoke and haze obscure the vast stands of trees in the path of a devastating fire in 1966. The area, with its new growth, is now a lush green.

From a tree, common red-shouldered hawk preys successfully on rodents and small birds.

Newcomers to North America, cattle egrets now thrive near ponds in the Park.

An alligator, momentarily safe from poachers, cruises tranquilly along lake shore.

rating opinion in Washington and throughout the country to save the Park. Park service personnel, themselves in the forefront of the fight, give Browder 90 percent of the credit for the final victory. Yet even with the advantage of the sudden national awareness of the ruined environment and the dwindling heritage, it was a close escape. Two cabinet officers and the President of the United States were involved in the final decision. As a concession the training strip is to be used temporarily for training flights and this, in the opinion of the ardent conservationists, poses some immediate threats of pollution. Moreover no new site for a jetport has been agreed on, with rival factions pushing competing plans. So the menace may still be as palpable as the gray mass of the far-flung city on the distant horizon.

Noise will be a factor in the use of the training strip with the likelihood of flights across at least one boundary of the Park. Air pollutants from these training flights will be another damaging factor.

A controversy between Secretary of the Interior Walter Hickel on the one hand and the consultants, including former Interior Secretary Stewart Udall on the other, leaves a site for the great jetport still hanging on the horizon as a continuing threat. As in the recent past when the conflict over the jetport was at its most acrimonious, the choice remains between the push for "progress" versus the preservation of the last of the American heritage.

Droughts cause catastrophic fires

In southern Florida, normally subject to droughts once or twice a decade, drainage or stoppage of the water flow can set up a deadly chain reaction. The most immediate effect in the Everglades is the killing off of large numbers of fish and other water-dependent animal life. When severe droughts bring on catastrophic fires, no living thing is safe—all of the wildlife in the path of the flames are destroyed along with their nests and burrows and water holes.

Such fires burn deep into the peat beds, destroying their sponge-like quality which normally stores and holds water. Alligators can no longer excavate holes in the peat beds which would create survival ponds for smaller aquatic creatures.

The reduction of water flows from man-caused drainage may have another long-term effect on the Park. It reduces the number of pink shrimp, tarpon and red snapper, and it may be destroying oyster beds.

Birds, particularly, find it difficult to reproduce during dry cycles. In perhaps only one of six nesting seasons have conditions in the rookeries been right for the wood ibis (wood stork), one of the endangered species in the Park. With a wing spread of five feet, it

is the only American stork and may have dwindled in population to a new low of 12,000. Four years ago, when there was a prolonged drought, the birds were forced to retreat to the farthest extremities in search of proper nesting places, and then they were seldom to be found. During the last two years there has been too much water. The Army Corps of Engineers, with their drainage canals, and the town site and agricultural developers constantly pushing down toward the boundary have upset the normal water flow which, with the exception of rare drought years, had preserved an ecological balance for the whole area over the centuries.

Today with intensive farming so close and the constant use of planes to spray fertilizer and hard pesticides, pollution of Park waters is serious. Unhatched eggs of the bald eagle have been found to contain a high content of DDT. Fish in the estuary absorb the pesticide in the water, the eagles eat the fish and the poison affects the reproductive process by reducing eggshell thickness. The boom from supersonic overflights and the pollutants from flights would be threatening enough, but the drainage and development of Big Cypress Swamp, part of the Everglades but not of the Park proper, would mean certain doom.

The hard pesticides such as DDT constitute one of the most serious threats to the wildlife in the Park. In each succeeding generation of both marine and bird life the accumulation of these poisons is progressive. There comes a point, as Rachel Carson so vividly and dramatically showed in *Silent Spring*, when the species can no longer reproduce itself or when reproduction is so marginal as to mean a steady decline in numbers. This point may already have been reached with the bald eagle and perhaps also with certain wading birds such as the herons. Park naturalists hesitate to make a final pronouncement, but they are far from optimistic.

When you drive from Miami to the Everglades and leave the ugly clutter of Route 1 to turn off into the newly developed intensive farming tracts you see why this is occurring. There parked on an airfield are three or four small planes that spray the fertilizer and the pesticides. This is hardly a carefully controlled process and there is the inevitability of overspill close to the Park's borders. The drainage from what is in effect hydroponic farming, with repeated forced crops, seeps into the Park through a variety of channels.

Sea cows and loggerhead turtles

Another hazard is what in the vernacular of the rangers is known as the hole in the doughnut. This is a tract of land in the center of the Park still privately owned and still used for farming, hunting and fishing. Thus far Congress has declined to appropriate funds to acquire this interior threat.

Above silhouetted fisherman, a bald eagle, an endangered species, perches near its nest.

All this has come about in an eyewink of time as time is measured astronomically. I spent the winter of 1932-33 with my family when our children were small on a beautiful and almost empty stretch of Florida's east coast. Alligators were in the swamp country between the Banana River and the shore. Deer were a menace to the few garden plots. A half dozen dwellings, largely unoccupied through the winter, were survivors of the mad boom of the '20s. The lore of the two or three old-timers was of the manatee, the big blunt-nosed sea cow that streamed down the Banana River into Florida Bay, and of the loggerhead turtles coming in the late spring to dig nests on the shoreline, lay their eggs in the soft sand and swim out to sea again. That was at Cocoa Beach, which the National Aeronautics and Space Administration transformed into a bustling city with neon-lighted motels and a constant influx of tourists.

Today, it is rare to find a stretch of undeveloped beach where the sea turtles can nest. One is Cape Sable at the extreme tip of the Park, and southernmost part of the continental United States, which still offers a nesting beach with security or at least comparative security. The rangers are their guardians.

Shyly at first, the turtles come flopping out of the sea in the middle of night. They scoop out their nests in the soft sand. So strong is instinct that, once started, they will continue to drop their eggs, more than 100 to a nest, even though an intruder stands by to catch the eggs. Raccoons from the scrub are the worst predators. The Park rangers have discovered that a two-inch wire mesh above the high-tide line will keep off most of the raccoons. But often on dark and rainy nights the rangers must stand guard against human predators with a taste for turtle eggs and turtle meat. The loggerheads average from 300 to 400 pounds, and for a native fisherman this is a profitable catch. Although far too few for the size of the job, it is to the credit of the rangers that they regularly cruise along Cape Sable, East Cape, Middle Cape and Northwest Cape on moonless nights trying to protect creatures that come out of the distant sea to find a last refuge. Having laid their eggs the turtles go back into the sea, and the young when they hatch two months later make straight for the water.

To catch a poacher takes both patience and tact. The old-timers and for that matter the young-timers, the natives who live off the sea and the land, are infinitely resourceful at disguising their purposes. In the great green watery emptiness of Hells Bay coming out of a narrow inlet, there suddenly is a fishing boat. We come alongside. Slow, casual talk. They are out of *Flamingo,* a fishing craft. They may be sport fishing or engaged in some form of legal commercial fishing. But again they may be out for purse seining, cutting off one of the remote waterways with their illegal nets, taking the profitable fish and leaving the others to die. If they are purse seiners the three quiet-spoken men in the boat have concealed the evidence. We go on.

The alligator poachers are the most murderous and the most persistent. That is where the money has been. The hides bring as much as $50 each.

Poachers wait for a dark night

With an assist from the phenomenal drought of four years ago, the poachers have reduced the gator population to perhaps ten percent of what it once was. They, too, wait for the dark nights when they pole silently up remote bayous. A bright flashlight brings the gator to a startled halt and a quick kill with a well-aimed rifle shot. During the worst of the drought when the gators sought the remaining water holes it was like shooting fish in a rain barrel. One determined young ranger set a stake out at Nine Mile Pond. Shortly after 3 a.m. the poachers opened up. They killed 17 alligators in rapid succession. As the ranger rushed into action they fled into the brush. They were not arrested until the next day and the judge let them off for lack of evidence. New laws that will hopefully stop interstate shipment of hides may make a difference. With good luck with the water level and new restraints on the illicit traffic, the present population may yet hold its own.

Even more endangered are the crocodiles—an almost vanished species of fewer than 100. But they may still be preserved in a state of nature. At the ranger station they have hatched a half dozen young with the hope they will grow large enough to release.

Yet for all the effort to preserve the wonderful sense of empty sea and empty sky in much of the Park, there is at times the impression of a preserve, a zoo even,

The map above shows the delicate relationship between the Everglades (including the Park and Big Cypress Swamp) and their surroundings. The uneven water flow from Okeechobee, pollution of Biscayne Bay from Turkey Point power plant and the spread of Miami, all are problems.

that owes at least as much to a few guardians as it does to the original state of nature. Once it has been encroached on, the guardians cannot preserve and protect the narrow shelf between land and sea that is the seedbed for so much of the marine life of Florida Bay and, incidentally, also for the bird life feeding on small aquatic creatures.

The gentle, steady flow of water across the Everglades—a table top ever so slightly tilted—has maintained the balance across thousands of years. Discharged into the sea at a fairly even rate, the estuary so created is the nursery for the life of the entire Bay. It is the genesis for some of the best sport fishing in the world and for Florida's shrimp industry which is a significant part of the economy. Until the developers began to intervene, the overflow from Lake Okeechobee, 100 miles to the north, helped to keep the water table up in times of drought. The flood-control system built by the Army Corps of Engineers in the aftermath of the all-but-catastrophic floods after World War II gives man the power to raise and lower the flow of water in accord with the needs of a half dozen or more claimants rating higher than the Everglades. "The result," as one biologist puts it, "is to create instant drought or instant flood for the Park."

Stripping away the mangrove with its roots half in and half out of the sea is the prescription for sterility; the end of the estuarine nursery is therefore the ultimate doom of the life of the Bay. That has happened in the northern end of South Biscayne Bay where the island of Key Biscayne is adorned like a wedding cake with the houses and the condominiums of the rich. The waters around the island are already seriously polluted from pesticides, oil and human wastes discharged into the sea at Miami and Miami Beach and the newer developments pushing without let or hindrance down the southern shore.

An effort to save a beseiged shore

To attempt to save some of South Biscayne Bay, the still clear offshore waters and the undeveloped islands and reefs, Congress authorized the creation of Biscayne National Monument to be administered as part of Everglades National Park. Large new developments had been and still are planned for South Biscayne Bay, a city of 400,000, and a second project nearly as large. Land acquisition for the Monument is taking place only one jump ahead of the speculators. At the same time, Florida is turning over claim to a part of the submerged lands that contain still-unexplored wrecks of Spanish galleons and British frigates from the 17th and 18th centuries. The most hopeful turn of events is a landmark decision ruling against a major polluter that would eventually have destroyed the seabed and the estuary further to the south.

The Turkey Point (both the common wild turkey and the anhinga, the water turkey or snakebird, were once plentiful throughout southern Florida) plant of the Florida Power and Light Company is the offender. The plant discharges water out of the boiler cooling system heated to 90 to 100 degrees into the Bay. Park Superintendent John Raftery estimates this has already destroyed 400 to 600 acres of the vegetation on the bottom of the Bay. But worse was to come.

The company was building two nuclear-powered generators and a six-mile canal that would have discharged a far larger volume of overheated water. At the end of a three-day hearing called by the Federal Water Quality Administration the company was given 60 days to come up with an alternative cooling system. It was the first case of thermal pollution dealt with by the federal agency in its efforts over 13 years to check the contamination of America's inland and offshore waters. Governor Claude R. Kirk jr. had requested intervention by the federal government and he was

represented at the hearing by Nathaniel Reed, chairman of Florida's pollution control agency. The precedent established on the besieged shore, where the creatures of land, sea and air once so prolific are making a last stand, holds a bright promise for conservation everywhere even though a long series of appeals in the courts may still lie ahead.

You have to search for these creatures today. Flying low in the plane with Ranger Pilot Ralph Miele we looked for manatee. Pretty hard to find, Miele said. We were skimming over a great emptiness of water and mangrove. There, look there, he suddenly said. In the clear water of a small cove were three objects. They were golden brown, two larger and one smaller, and as we circled and came back it was possible to detect their slow movement. Yes, they were manatee, the survivors like the whooping cranes which have so narrowly escaped the slaughter of the recent past.

Now and then some rare creatures have had unexpected breaks. In the early years of this century the commercial kill of egrets, roseate spoonbills and the white heron was appalling. Their plumage was sold for the hats of fashionable ladies. But as the cry of extinction arose they were given protection, and they began slowly to come back. That is, they began to come back until their nesting and breeding grounds near the Park were usurped by the builders. Today a few thousand roseate spoonbills may exist in the Park and the number will increase under protection.

Those who speak for "progress," for jetports, for big new housing developments that preempt the sand, the sea and the sun, have long been contemptuous of the

conservationists. "They'd give everything to the birds, they'd rather have birds than people." This is the complaint. It has great weight in view of the relentless push of people in search of sun with, preferably, a small touch of the natural environment that may survive. This last is rare and like that greatest of today's luxuries, privacy, only for a relative few.

Granted that the Everglades are a special taste. No spectacular waterfalls, no geysers, no towering mountains. The word may be serenity. I think of this as I watch a blue heron stalking the shoreline in search of an early supper. With his dignified walk, putting those pipe stems up and down so deliberately, he has the air of a self-respecting senior citizen, knowing his rights and cherishing the hope that those rights will be respected by others.

It is the end of the day. We are lucky in that a flock of roseate spoonbills has settled on the sandbar off the Flamingo Motel which is the tourist center. When viewed through binoculars they come to life, the russet, reddish glow of their plumage. At the other end of the sandbar are the white pelicans, a dwindling species that each year makes the pilgrimage from the Pacific northwest to Florida Bay. The campfire is lighted as darkness comes down. A park naturalist begins her talk about the wonders the visitors have been seeing. The cycle of the tourist, the cycle of that family from Tennessee listening so earnestly in the firelight to the naturalist's lecture, the cycle of the vanishing creatures of the shining ocean of saw grass, can they coexist? That is the question as the fire flickers down and the lecture ends.

On a sandbar near the Flamingo Motel, white pelicans convene—undisturbed by sightseers.

Nancy Pearlman of UCLA flashes a peace sign as she leads a "bike-in" through exhaust-choked Los Angeles. "We must stop trying to conquer nature," she says, "and learn to live with it."

Battle to save our grimy environment gets fresh recruits

Voices of youth support a challenging cause and blend with those of worried elders; oratory and demonstrations are only a start

In a springtime scene, Donna Omohundro of Iowa's Cornell College says, "Recycle resources."

Classmate John Taapken: "We must control population; we must control industry."

This spring has seen student demonstrations take on a new dimension. The young cut classes, hold mass meetings on their campuses, invade downtown streets and parks and disrupt traffic by riding around on bicycles. They parade in gas masks, stack piles of trash on municipal doorsteps and hand out flowers. All these actions are the familiar ploys of protest, but they are earning general approval and applause. Only occasionally are these activities dismissed as the rites of spring or decried as part of a communist plot.

The new student cause is our beleaguered environment, and most adults only regret that more young people have not rallied to it. Everyone says he loves the environment, so those who carry the picket signs seem to be clad in bright armor.

Environmental demonstrations range from riding horseback on a freeway to prove there are other ways of getting around than by car, to wearing buttons inscribed with a picture of Earth and the words, "Love it or leave it." The sloop *Clearwater,* a replica of the Hudson River sailing vessels of a century ago, reminds its visitors that the Hudson was once a pristine mountain-fed stream. It sailed up the Potomac to Washington and found it even filthier-looking than the Hudson. In New York City, on "Earth Day," the internal combustion engine was banned from 45 blocks of Fifth Avenue (pp. 18-19) and crowds rambled happily along a street free of stench and noise. "We should do this every Wednesday," said a lady from Long Island.

Perhaps we should. But more important than oratory in the long run is action, the bills to be passed, the laws signed and citizens' participation as individuals.

Improving our earth is an issue with profound effects on human life. Whether or not the cause stays before our eyes, the grim problem will remain.

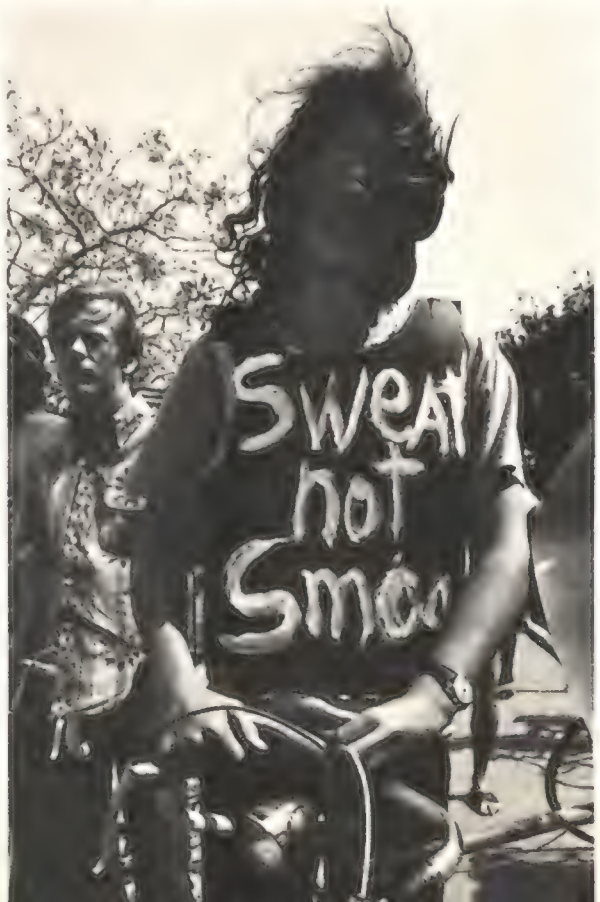
Bike-in at UCLA,

Susie Murphy at UCLA Bike-in, organized to promote a pollution-free alternative to the automobile.

"Clean Air Pod" at Berkeley, inflated with filtered air, could be used as "air emergency" shelter.

Actor Ed Perish blames auto industry for California smog, but says individuals must persuade elected representatives if they want anti-pollution legislation.

The sweatshirt of Doug Kirk, UCLA, carries its own message; sign on his back reads "Organic exhaust." He wants protective laws and special cycle routes.



Tony Marienthal, 9, a pupil at UCLA's elementary school, is starting young to influence people to "use bikes rather than cars to go to school and work."

clean air at Berkeley

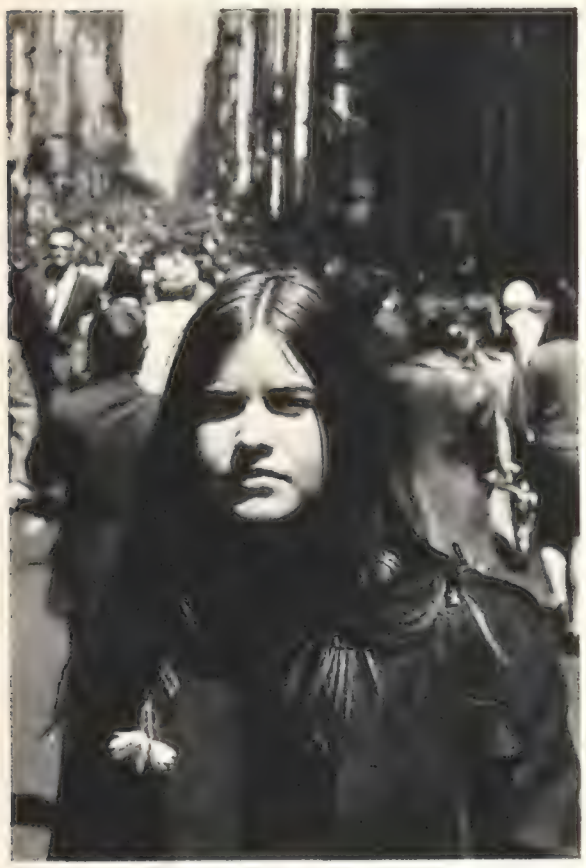
Elaine Gruetzner in the Air Pod: "Something has to be done right now or there won't be any Earth."

Jim Pepper, Berkeley graduate student: "I think what we've stirred up has the potential for a revolutionary movement —for a genuine cultural revolution."

Marshall Owens, Berkeley: "The world could come to an end with this ripping up of the land. Maybe this will tell the government that people are interested."

Tim Campbell, graduate student: "We've got to persuade state and national figures to examine what environmental quality is—*and how do we get it?*"

Large crowds, small groups march and hold services



Catherine Wood, environmental design student in Philadelphia, thinks "new biodisposable products must be designed or we will choke in our own garbage."

"I know the earth needs cleaning," says Sally White, a Marymount sociology student. "Maybe I'll do something. We have to learn new techniques."

Larry Rosenberg of New York University feels that government is at fault. He blames fear of big business but says, "maybe *we* can do something."

"I just came here to eat lunch," Columbia's Jerry Sachs admits. "I don't understand why ecology is so popular—it seems like a fad."

New Yorkers displaced cars on Fifth Avenue from 14th to 59th Street.

In Northampton, Mass., a sunrise service, two hours delayed, still got only a few early risers. Smith College girls sang and heard biologists speak.

Dead Orange Parade in Miami suffered from disorganization and small turnout. There were "polluted floats," and slogans like "Save Surfing."

James Tracy, a senior on an Earth Day committee at Ohio State, told a small crowd that community action will come; "pollution is so hard to ignore."

Do-it-yourself in California and Wisconsin

At Coyote Point, San Mateo, Calif., volunteers from many conservation groups lift tires to dikes for truck pickup.

Judy Pierce, Shorewood, shows her muddy hands and says: "It makes me feel better to do just a little bit."

Milwaukee suburban high school juniors from Shorewood (left) try to fish litter from bank of the Milwaukee river.

Helicopter lifts tires at Coyote Point; cleanups here removed only a fraction. Conservation efforts left most of San Francisco Bayshore still full of litter.

By Carol Cutler

U.S. at the Biennale: a new look for the Carnival of Venice

The world's biggest art extravaganza goes on as before, although perhaps not quite in the old way. There are new ideas

The screaming, belligerent Italian students did it. They saved the Venice Biennale. Not intentionally; in that troubled June of 1968 their goal, in fact, was to prevent the 34th Biennale from opening once and for all. But their loud protests against all that the Biennale stood for forced the government of Italy to take a hard look at the condition of the world's oldest continuing international art festival. At last it was officially recognized that the patient was very sick indeed, a diagnosis that had been made long ago by many participants. A strong remedy was urgently needed and several were prescribed. So this June 24 the gates will swing open on a 35th and, hopefully, improved Venice Biennale. Complete recovery is still a long way off, but finally the art extravaganza seems to be headed in a healthy direction.

For a long time students at Venice's Accademia di Belle Arti had been unhappy with the conservative (to put it kindly) instruction they were getting. Riding the groundswell of worldwide student unrest, they boycotted classes and later seized some studios in the handsome old Academy building. Triumphant, they looked around for another target. The poor Biennale, staggering under the weight of too many years of stagnation, political maneuvering and venality, was easy prey.

The art students prepared a manifesto addressed to "Workmen, Companions" and protested against the usual things—capitalism, bosses, bourgeois society, shortage of direct contact among artists, lack of social usefulness. And, naturally, the police. Although they tried to prevent the doors from opening at all, the protesters merely delayed the ribbon-cutting by a few days. Perhaps their sabotage could have been more effective. But they were Italian, and this was Venice in late spring: large groups of demonstrators only started boarding *vaporetti,* a good half-hour's boat ride from the Biennale grounds, when they should have been already at the gates.

Unexpectedly, help flowed to the students from many foreign exhibitors. The agitation acted as a catalyst for the dissatisfaction and dissent that had been simmering among them for many years. The usually festive atmosphere that surrounds a Biennale opening turned acrid. Loud arguments in many languages could be heard along almost every canal; parties were canceled; and some pavilions closed their doors, completely or partially, depending on the sympathies of the artists.

When one stood back from the feverish scene and tried to pinpoint the problem of the Biennale, there was an inescapable answer that coincided with the students' complaint: the system. Unprincipled trading for prizes, political selection of artists by national commissioners, drum-beating and worse by dealers—all had helped to sap the energy and integrity of the event.

One big step has been taken to correct these evils: all prizes have been abolished. This decision should automatically eliminate most of the bartering and maneuvering that were the shame of the Biennale. For years more prizes were "earned" by dubious deals at

William Weege, at work in his Wisconsin studio, cleans a silk screen after making a print. He will be using the same techniques in Venice.

the Café Florian in the Piazza San Marco than by talent exercised in artists' studios.

Some of the 30-odd countries that normally take part began to reassess their roles, and 17 of them came out for more "artist involvement." What that means in their case will not be evident until the exhibition opens, if then. But the United States has already reacted by tossing out the old format of a static painting and sculpture presentation and replacing it with a graphics workshop.

This is a big change. In the past the U.S. entry, like those of most other countries, has consisted of a limited number of major works by a handful of artists with glossy reputations, chosen to reflect current trends but also with an eye to providing maximum visual impact. To argue that the latter quality has nothing to do with art is beside the point. At Venice, with nearly 3,000 works of art clamoring for attention, it is necessary to raise one's voice. Furthermore, the American presentation, which is seen in a setting of lavishly endowed foreign pavilions, has always had to run on a shoestring; yet it is expected not only to hold its own but to make our cultural image shine more brightly.

This takes some doing. In recent years, and again in 1970, U.S. participation in all the big biennials has been organized and sponsored by the International Art Program of the Smithsonian's National Collection of Fine Arts. There may be some who will see in this year's workshop formula a retreat from trying to compete on a big-name, big-art scale, but competition—overt, at any rate—is no longer the name of the game. "We are looking for an opportunity to bring artists from many countries together for work and the exchange of ideas," says Lois Bingham, director of the International Art Program, "and we would like to place more emphasis on creativity than on the commercial end product." She also points out that a lot of good artists "who are not straight printmakers have become increasingly involved with the graphic arts," a move reflected in the current boom in interest and prices of prints.

The American pavilion in the Biennale grounds does not have the space to accommodate a real workshop, nor with a throng of visitors milling around would it be an easy place for an artist to work. So the pavilion will be used to exhibit about 90 works in all graphic media, and for demonstrations on a lithography press and a silk-screen table.

The workshop itself will be housed in the former U.S. Consulate building on the Grand Canal, next door to Peggy Guggenheim's palazzo-museum and, *pace* angry art students, not far from the Accademia. By a fortunate accident of location, the consulate happens to be in a quarter that is becoming increasingly popular among serious Venetian art dealers, who are beginning to pull away from the Piazza San Marco and its glut of tourist-oriented art.

The program will be administered by Henry Hopkins, director of the Fort Worth Art Museum. Under him are to be two artist-teachers in residence, William Weege and Jack Damer. Weege will be in charge of the workshop and will conduct the serigraphy (or silk-screen process) sessions; Damer is to be responsible for the lithography courses. Both are considerable artists in their own right and both are from the University of Wisconsin. Why Wisconsin? Because these days genuine creativity in the arts is by no means confined to New York and Los Angeles and because Wisconsin, according to Weege, "has the best graphic facility in the world."

The All American Artist-Printer

Weege is an ebullient man with an engagingly flamboyant life-style that involves dogs, horses, three children, an imaginative wardrobe and a farm in Black Earth, Wisconsin, where he has his studio in the hayloft of the barn. He turns out his prints under the rubric of Shenanigan Press, Ltd., and on his letterhead describes himself as "All American Artist-Printer." But for all the fun and games, he is a deadly serious artist, thoroughly knowledgeable about his craft and open-minded about the possibilities of modern technology (some printmakers tend to be very stiff about using anything but the traditional techniques).

Both he and Damer are enormously enthusiastic about the Venice workshop project and its opportu-

Carol Cutler recently returned from Paris, where she was art critic for the International Herald Tribune *and covered several Biennales.*

nities for drawing artists and students together, whatever their nationalities. Six American graduate art students have been invited to spend the summer at the workshop, and may receive full college credit for their work there. At the same time, small groups of students from other countries—perhaps five such groups in all—will be brought to the Consulate to work alongside the Americans. Finally, there will be a changing roster of established artists, both American and foreign, who are skilled in graphics and will be invited to make use of the workshop facilities and work with the students. Supplementary activities will include seminars, informal discussions, critiques, demonstrations, lectures and film series. All of this, as was pointed out in the U.S. proposal to the Biennale committee, can be considered "a pilot project to test the validity of drawing together an international group as working colleagues in a creative art center." It is not going to be cheap; an activity like this can eat up more money than the traditional exhibition where the biggest costs are fixed and final. And it could not be accomplished without generous private support in addition to the available federal funds.

As exciting as the new workshop approach seems, old Biennale-watchers are raising some nagging questions. The one most often mentioned seems to be: "Is the general public being considered sufficiently?" In its formal proposal to the Biennale committee, the International Art Program said: "The core of this group would consist of artists ranging from students to famous masters and would attract the interest of other artists, teachers, critics, museum people, collectors and the like. . . . Although the workshop courses, seminars and critiques would be primarily for the enrolled students, portions would be open to serious interested visitors. The rest of the program, meaning the exhibition and demonstrations in the pavilion, would be for students, artists and the general Biennale visitors alike."

Rightly or wrongly, "general Biennale visitors" come rather far down on this list. There are those who worry that at this moment in art history, when more involvement and active participation is being encouraged for the general public, the emphasis on the workshop will tend to exclude them from the most important part of the project. The Italian government might be expected to share this worry, since the Biennale—whatever else it is—is a prime tourist attraction. Most of the museum people, dealers, artists, collectors and other members of the art establishment who descend

The Weege family with some of their pets. His studio is in the old barn, the horses having been evicted to the small building at the left.

on Venice for the opening festivities, rarely stay more than a week, and then usually dash off to Kassel, Germany, to see *Dokumenta,* currently the "in" show in the international art world. During the 1968 Biennale, which ran from the end of June until mid-October, the bulk of the visitors to the exhibition grounds were interested spectators but not committed art enthusiasts. They came to see the most glamorous art show of all, and they were little concerned with what went on behind the scenes. These, the general public and the passing tourist—who pay the admission fees and the hotel bills—are the bread and butter of the Biennale. And yet the committee, concerned as it may be about them, warmly approved the American proposal for a workshop.

There is a good reason for the general attraction and fame of the Biennale, unrivaled by any other major art exhibition for sheer drawing power. How can any other city in the world compete with glorious Venice, afloat (though barely, these days) on its lagoon? What other art show requires you to take a marvelous 20-minute *vaporetto* ride before you reach its gates? The garden setting, too, is inviting; the pleasant stroll from pavilion to pavilion revives the mind and eye, if not the feet, between the sessions of concentrated looking.

The Biennale originated as part of the festivities marking the silver anniversary of the wedding of King Umberto I and Queen Margherita of Savoy in 1893. Although the plans were laid that year, it was not until 1895 that the first *Palazzo dell' Esposizione* opened its doors in the Giardini near the entrance to the Grand Canal. The area was at that time a public garden, built on land reclaimed from the Adriatic during the Napoleonic occupation.

Although originally conceived as an all-Italian art display, plans were changed before the opening and more than half of the 516 catalogued works in the first show came from abroad. The international character of the exposition helps to account for the large attendance; it would be hard to attract 181,383 visitors, as the 1968 Biennale did, if the art fare were more limited, either geographically or stylistically. There is piquancy in the enormous range of the works on display, all the way from plodding Soviet Socialist Realism to mad arrangements of fur or what-have-you by the Italians.

The pavilions that are scattered over the grounds are all permanent structures, designed, built and maintained by the nations that occupy them. As a result, most of them reflect to some degree the traditional architectural style of the country—the American pavilion for example, is fake Georgian.

The durability of the Biennale seemed to indicate that as long as there was a Venice, it would have its every-other-year festival of contemporary art. But then it was rudely jolted by the demonstrating students. And now there is serious concern around the world as to how long there will actually be a Venice, at least as we know it. The city has withstood the Doges and their violent intrigues, plagues and foreign occupation. But if it does eventually succumb, it will be to the very thing that makes it unique: its water.

Rising tides, sinking foundations

Today, conservationists look with horror on the continually rising level of the tides that flood much of the city. Their concern is much different from the reaction of John Ruskin, who enjoyed the phenomenon from the security of the 19th century. In 1851 he wrote in *The Stones of Venice:* "During the period of highest tides, the city is exceedingly beautiful; especially if, as is not unfrequently the case, the water rises high enough to partially flood St. Mark's Place. Nothing can be more lovely or fantastic than the scene, when the Campanile and the Golden Church are reflected in the calm water, and the lighter gondolas floating under the very porches of the façade."

Obviously, the flooding problem is not new—just the way of looking at it. For centuries Italian engineers and officials took little notice of the threat. Biennale officials are not waiting quite so long; they have studied their own weak points and have started to shore up their foundations. The new type of American participation, it is hoped, will help to strengthen the Biennale against the tides of dissatisfaction.

"We're a bunch of hams," says Weege of himself and his wife (opposite)—a not inconsiderable asset for anyone participating in a Biennale.

By Sherwood Harris
Introduced by Captain Walter M. Schirra jr.

A raw December day at Kitty Hawk

Man's original 'giant steps' are remembered in these excerpts from The First to Fly, *a book which will be published this month*

Before our first manned space flights, we often related ourselves to the Wright brothers. We told ourselves that, like them, we were pioneers.

Sherwood Harris' book, *The First to Fly* (Simon & Schuster, $7.50), makes it quite clear that we were in gross error. The Wrights worked almost all alone, financing themselves without help from the government. They succeeded in solving the problems of lift and control, and they built their own engine and propellers. As author Sherwood Harris relates, "the homemade gasoline engine . . . didn't run very well. The Wrights' mechanic, Charles E. Taylor, had to squirt oil around the bearing surfaces by hand before starting it up each time and then the engine would run less than a minute before it began seizing up."

What a difference from today, when air travelers are dismayed if they have to fly in propeller-driven "piston-slappers" instead of high-speed jets. People now demand flights in great aluminum clouds such as the 747, within which they can walk farther than the Wrights' entire first flight.

In December 1968, I received the Kitty Hawk Memorial Award in recognition of my three earth-orbital flights, culminating with the first of the Apollo flights. The symbol of the award is a large hourglass with a divider that separates the sands of time. On one side is sand from Cape Kennedy; on the other, sand from the Wright Memorial site at Kill Devil Hills, near Kitty Hawk, North Carolina.

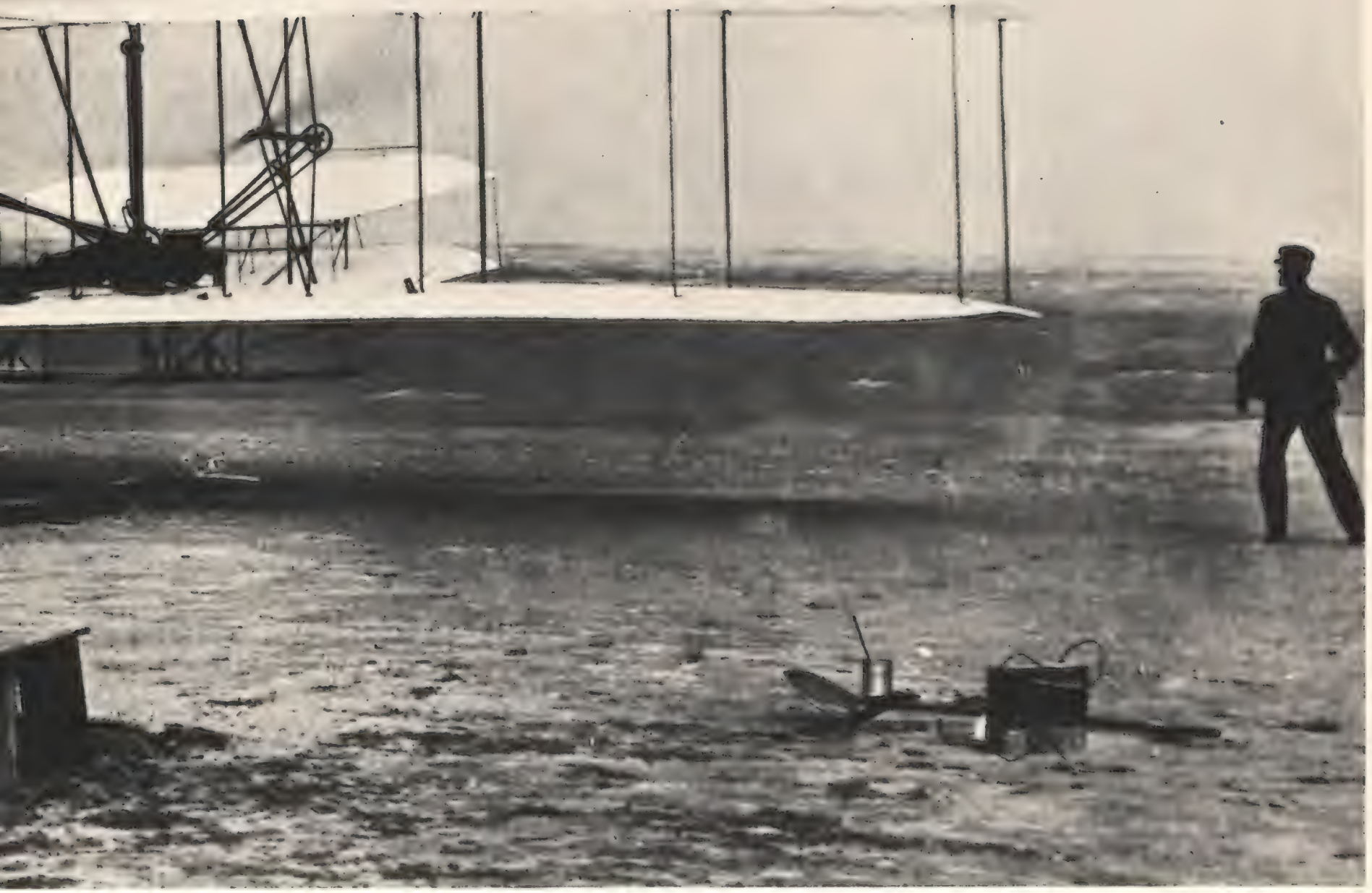
Sherwood Harris, flyer and aviation writer, is an editor of Reader's Digest. *Schirra, one of the seven original astronauts, commanded the first of the Apollo flights in 1968.*

Wright plane leaves its rail on man's first flight. Orville, prone at controls, raises horizontal "rudder" to provide lift. Wilbur runs alongside.

Harris takes us to the latter place, mentioned above by Captain Schirra, in the fall of 1903 and makes it clear, by publishing the following letter from Orville Wright to his sister Katherine, that the Wright camp was no paradise:

We reached camp Friday noon, having come over from Manteo in a small gasoline launch. We found everything in pretty good shape. The building, however, is several feet nearer the ocean than when we left last year, and about a foot lower in places. We had supposed two years ago when the wind at a speed of

From *The First to Fly: Aviation's Pioneer Days* by Sherwood Harris. © 1970 by Sherwood Harris. Reprinted by permission of Simon & Schuster Inc.



107 miles per hour took the anemometer cups away with it (beating anything within the memory of the oldest inhabitant), and when the mosquitoes were so thick as to dim the very brightness of the sun, exceeding in numbers all excepting those that devoured the whole of Raleigh's settlers on Roanoke, and last year when lightning turned night into day, and burned down every telegraph pole between here and Kitty Hawk, we had supposed that nature had reached her limit; but far from it!

Dan says this year has been one continuous succession of storms of unprecedented severity; the rain has descended in such torrents as to make a lake for miles about our camp; the mosquitoes were so thick that they turned day into night, and the lightning so terrible that it turned night into day. Really it paralyses the mind to try to think of all these things at once. . . .

We have started the new building and will probably have it pretty well up by the end of this week. We will have the old machine ready for practice on days of good winds, and will work on the new machine on rainy and calm days. The hills are in the best shape for gliding they have ever been, and things are starting off more favorably than in any year before. . . .

The transition from glider to powered flying machine [writes Harris] was a tremendous step; the 1903 airplane reflected this in almost every detail. The pilot was still going to lie prone on the bottom wing, but with him stretched out like this, the only place for the engine had to be to one side of him. However, the engine weighed 34 pounds more than either potential pilot; thus the airplane was unbalanced. The Wrights corrected this by adding four inches more to the wing

on the heavy side. The additional wing span was expected to create additional lift on that side and cancel out the extra weight of the engine.

Instead of a single propeller, the brothers decided to use a pair of propellers rotating in opposite directions. In addition to producing thrust, a whirling propeller produces torque, or a twisting force that tends to turn an airplane to one side. The Wrights figured correctly that they could cancel out this sidewise pull by mounting two propellers that would turn, and thus pull, in opposite directions. Connecting the propellers to the engine was the only feature on the machine that betrayed its humble bicycle shop origins—a chain-and-sprocket drive. . . .

At half past one on the afternoon of Monday, December 14, the Wrights . . . started walking their machine toward the Big Hill. There they were met by six men from the lifesaving station, who helped them lug the 605-pound aircraft up the slope. . . .

Unfortunately the attempt on Monday was a flop. This is Orville's account of what happened:

After testing the engine, with the help of men (Bob Wescott, John T. Daniels, Tom Beacham, W. S. Dough, and Uncle Benny O'Neal), we took machine 150 ft. uphill and laid track on 8° 50′ slope. A couple of small boys, who had come with the men from the station, made a hurried departure over the hill for home on hearing the engine start. We tossed up [a] coin to decide who should make first trial, and Will won. After getting adjustments of engine ready I took right end of machine. Will got on. When all was ready Will attempted to release fastening to rail, but the pressure due to weight of machine and thrust of screws was so great he could not get it loose. We had to get a couple of men to help push machine back till rope was slipped loose. While I was signaling man at other end to leave go, but before I myself was ready, Will started machine. I grabbed the upright the best I could and off we went.

By the time we reached the last quarter of the third rail (about 35 to 40 feet) the speed was so great I could stay with it no longer. I snapped watch as machine passed end of track. (It had raised from track six or eight feet from end.) The machine turned up in front and rose to a height of about 15 feet from ground at a point somewhere in the neighborhood of 60 feet from end of track. After thus losing most of its headway it gradually sank to the ground turned up at an angle of probably 20° incidence. The left wing was lower than the right so that in landing it struck first. The machine swung around and scraped the front skids so deep in sand that one was broken, and twisted around until the main strut and brace were also broken, besides the rear spar to lower surface of front rudder.

Some aviators might have been tempted to call this first 60-foot hop a "flight," [Harris comments] but not the Wrights. However, they were now confident of ultimate success. They got off a telegram to their father telling him ". . . success assured keep quiet. . . ." Thursday, December 17, was perfect for flying, though seasonably cold. The wind was blowing from the north 20 to 25 miles an hour and the puddles near camp were covered with ice. The two brothers waited awhile to see whether the wind would hold. By this time they had been at their camp eighty-four days, their food was mostly beans, it was beginning to be bitterly cold, and they knew their machine would work. So they hoisted their signal and were soon joined by several men from the lifesaving station. They must have been moved by an uncanny sense of history that morning, for they painstakingly adjusted their cumbersome glass-plate camera so that it could snap a picture at the precise moment of lift-off.

Again Orville's diary preserves the flavor of the historic occasion:

After running the engine and propellers a few minutes to get them in working order, I got on the machine at 10:35 for the first trial. The wind, according to our anemometers at this time, was blowing a little over 20 miles (corrected) 27 miles according to the Government anemometer at Kitty Hawk. On slipping the rope the machine started off increasing speed to probably 7 or 8 miles. The machine lifted from the truck just as it was entering on the fourth rail. Mr. Daniels took a picture just as it left the tracks. I found the control of the front rudder quite difficult on account of its being balanced too near the center and thus had a tendency to turn itself when started so that the rudder was turned too far on one side and then too far

on the other. As a result the machine would rise suddenly to about 10 ft. and then as suddenly, on turning the rudder, dart for the ground. A sudden dart when out about 100 feet from the tracks ended the flight. Time about 12 seconds (not known exactly as watch was not promptly stopped). The lever for throwing off the engine was broken; and the skid . . . cracked.

Then it was Wilbur's turn again. Orville continues his narrative:

After repairs, at 20 min. after 11 o'clock Will made the second trial. The course was like mine, up and down but a little longer over the ground though about the same in time. Dist. not measured but about 175 ft. Wind speed not quite so strong. With the aid of the station men present, we picked machine up and carried it back to the starting ways. At about 20 minutes till 12 o'clock I made the third trial. When out about the same distance as Will's, I met with a strong gust from the left which raised the left wing and sidled the machine off to the right in a lively manner. I immediately turned the rudder to bring the machine down and then worked the end control. Much to our surprise, on reaching the ground the left wing struck first, showing the lateral control of this machine much more effective than on any of our former ones. At the time of its sidling it had raised to a height of probably 12 to 14 feet.

The last flight, made by Wilbur, was the most spectacular and satisfying of all. Again Orville describes it in his diary:

At just 12 o'clock Will started on the fourth and last trip. The machine started off with its ups and downs as it had done before, but by the time he had gone over three or four hundred feet he had it under much better control, and was traveling on a fairly even course. It proceeded in this manner till it reached a small hummock out about 800 feet from the starting ways, when it began its pitching again and suddenly darted into the ground. The front rudder frame was badly broken up, but the main frame suffered none at all. The distance over the ground was 852 feet in 59 seconds. . . .

A note from Capt. Schirra:

Oddly, after the Wrights' first successful flights, the American public was apathetic. It took foreign enthusiasm to encourage early pioneers to continue with their experiments. It is still exciting to read this document about those who first left the surface of the earth in powered flight—a step that led toward the moon.

Glenn Curtiss, aeronaut and engine manufacturer, tests his 1912 "headless pusher," so-called because it lacked a forward elevator and used a pusher propeller. It is on view at the Smithsonian.

Dr. Samuel P. Langley, the Smithsonian Secretary, gathered crucial data on flight from his models. Here he briefs the shirt-sleeved pilot of his "aerodrome" before its unsuccessful flight in 1903.

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In Los Angeles alone, Reynolds test program got people to redeem over 1,000,000 aluminum cans per month. Now we're working on sixteen more states.

Answers to the hard problems—such as litter and solid waste disposal—don't come easy. But, with effort and persistence, they do come.

Reynolds has working proof of this with its anti-litter, aluminum can recycling program. Starting in Miami over three years ago, we've developed approaches that are now about to be put to work in 16 states.

They'll be pulling used aluminum cans and other discarded aluminum products off the scrap

heap and back to our reclamation plants. They'll be helping to clean up our streets and conserve our nation's resources at the same time.

Los Angeles gets involved.

We know these programs work. One plan, with a Reynolds promotion drive behind it, has Los Angeles citizens bringing more than *a million cans a month* into our plant there. It has not only made Los Angeles people more aware of their litter problem, it has *involved* them, stimulated them into doing something about it.

Now we're expanding our Miami effort to cover all of Florida. We'll be launching our campaign in New York City, and will move into northern New Jersey, Houston, San Francisco, and the Pacific Northwest.

In addition, we are working with Adolph Coors Brewing Company of Colorado to help reclaim their used aluminum beer cans. We'll be taking their cans from Arizona, Colorado, New Mexico, Wyoming, Utah, Nevada, Kansas, Oklahoma, Texas, and California.

Used aluminum is valuable.

What makes the program work is the basic value of aluminum itself. Scrap aluminum is worth $200 a ton, because it can be melted down and reused so readily. Scrap steel, by comparison, brings only $20 a ton; paper, $16 a ton.

So used aluminum cans are worth picking up, worth saving and taking to a reclamation plant. Reynolds is able to offer ½¢ per can, and to suggest that Boy Scouts, hospital charity groups, and other organizations—and individuals—raise funds by collecting and returning aluminum scrap.

They're taking our suggestions. One million cans that don't show up in Los Angeles garbage heaps every month prove that.

Letters for anti-litter.

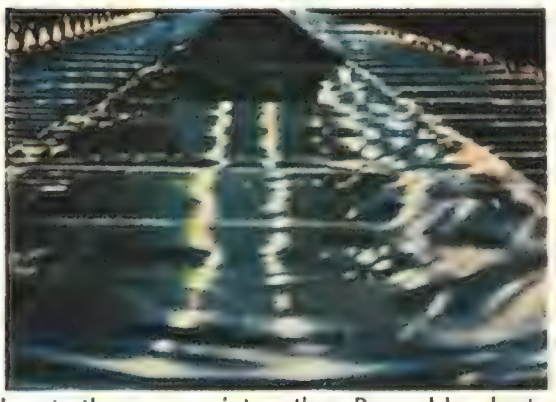
Our anti-litter efforts have brought us much applause from Boy Scout officials, Congressmen, Keep America Clean groups, civic leaders, and many others. But our chief satisfaction is in being able to help with this most difficult and important problem. We intend to keep at it, and to work even harder. Reynolds Metals Company, P.O. Box 2346-LMM, Richmond, Virginia, 23218.

REYNOLDS
where new ideas take shape in
ALUMINUM

Individuals and organizations bring all-aluminum cans to the Reynolds reclamation center.

Used cans pass through a magnetic separator and are then shredded.

After shipment to reclamation plants, the shredded aluminum is melted and cast into secondary ingots.



Ingots then move into other Reynolds plants to be formed into sheet, plate or other mill products.

The recycled aluminum re-enters the economy in a variety of attractive, durable new products.

By Craig Phillips

By night and day the coral reefs are places to share

Swimming, creeping and crawling things—plants, animals and in-between life forms—help one another in a complex realm

Photographs by William K. Sacco

Few places on earth have so many or so varied living animals as the coral reefs. Each of these creatures is somehow dependent on the others. Together they share one universal characteristic that sets the coral reef fauna apart from that of other ocean habitats—the brilliant colors and patterns. Some biologists think that the striking patterns serve as species recognition for association in schooling, mating and the like where many species normally live near one another. Another reason may be that since a coral reef offers extreme protection (there is almost always a crevice, hole or other hiding place immediately at hand where a fish can escape a larger predator), there is little ecological suppressing action against those evolutionary sequences that make a creature highly visible.

In the open sea and along sandy shores the situation is quite different. There the coloration is protective, and fish usually are silvery or whitish on the sides and belly, and, if they happen to be surface swimmers, bluish on the back. Since many surface swimmers, and schooling fish in particular, do not pair (except perhaps momentarily) but drop their eggs and sperm together as a group activity, bright color patterns for species recognition would be superfluous as well as detrimental in signaling a potential predator.

Whatever the underlying reasons, color, patterns and bizarre shapes reach their full potential on the reefs. And as might be anticipated in a community consisting of so many life forms, considerable interaction occurs among certain species, even among those of widely different divisions of the animal and plant kingdom.

Typical of the bright reef inhabitants are the parrotfish and their relatives the wrasses, both of which show varying degrees of sexual dimorphism; the adult males and females are sometimes so different in color and shape that they have often been described as different species before their complete life histories were known. Wrasses have separate teeth and tend to be bucktoothed, whereas parrotfish have teeth that are

The author is assistant curator of the National Fisheries Center and Aquarium. Formerly curator of the Miami Seaquarium, he is author and illustrator of the aquarium book, The Captive Sea.

Sleeping parrotfish is wrapped in a plastic-like mucous "cocoon." One assumption is that it repels predators by its bad taste.

fused to form a remarkably birdlike beak, bright blue in some species. With it the fish crunches up quantities of growing coral, ingesting the living matter and grinding the rest to a fine powder. Gradually parrotfish actually create sandbars between coral patches by this process. The parrotfish is also recognized by its large regular scales and its leisurely manner of rowing itself along with its front fins, body held straight, a trait shared by several other families of reef fish.

Recently it was discovered that many parrotfish, like the one in the picture above, have the interesting habit of sleeping on the bottom in bag-shaped mucous "nightgowns" or "cocoons" which they secrete. The exact purpose of the bag is unknown, but it may offer protection to the resting fish either by preventing its natural odor from being detected by sharks, morays and other night feeders or by being distasteful or otherwise objectionable.

Although the parrotfish is unique in wrapping itself, many fish including many reef dwellers rest on the bottom at night, often leaning against a rock or a piece of coral. Triggerfish jam themselves into crevices in awkward positions whereas the wrasses frequently bury themselves in the coral sand with just the mouth exposed.

Day and night show interesting contrasts on the reef. Only with development of nighttime underwater photography, such as that of Mr. Sacco, have we docu-

Coral at night blooms as tentacles with white stinging cells emerge to seek light-shunning zooplankton that arise from the depths. These tentacles catch whatever the animal eats.

Coral by day is stark and dull. Tissue hides bone-like skeletons of which the reef is built. In the absence of food, oral openings close and tentacles are withdrawn.

mented that most corals present quite a different appearance in dark and light. Except for a certain amount of surface color, corals with their polyps contracted by day show about the same appearance as the dried coral skeletons that most persons have come to know as coral. But nighttime brings a transformation as the plankton-feeding polyps expand into full "bloom," frequently showing colors that are otherwise well hidden. Each individual polyp bears a circlet of tentacles reminiscent of its larger relatives the sea anemones. As with anemones these tentacles have microscopic nematocysts, stinging cells with which the minute plankton organisms are immobilized before being conveyed to the central mouth and swallowed.

Although most coral polyps are very small, there are some exceptions. The one-and-a-half inch *Tubastrea* polyps, which frequently grow in small clusters on the sea floor, are relatively large. The brain coral (so-named because of the resemblance of its surface furrows to the convolutions of a human brain) is something of a puzzle; its surface seems to be made up of one long, continuous polyp. In the course of evolution, brain-coral polyps have become joined to one another in such a way as to lose their individuality.

Some fish that normally hide by day come forth from the holes and crevices to feed at night. These include such diverse species as the cardinalfish, squirrelfish, bigeyes and moray eels. Active predators, most morays have powerful jaws, elastic throats and needle-sharp teeth with one extra row down the center of the roof of the mouth. Having keen smell, morays are adept at tracking down almost any prey that can be swallowed, and should the prey be too large for swallowing, the moray has developed an ingenious system for tearing it apart. It ties a knot in the end of its own tail; then it rapidly works the knot forward along its own body and over its head. Then using the knot as a support to work against, the moray bites off swallowable pieces of flesh with a jerking, twisting motion of its head and neck.

The rock morays of the genus *Echidna* like the one shown on the next page are somewhat different, generally having small, thick bodies. The teeth are short, blunt and molar-like, designed for cracking the shells of the mollusks and crustaceans on which the creatures largely feed. Rock morays are frequently found close to shore, lying partially exposed in crevices at low tide, and do not appear to be as strictly nocturnal as their larger relatives.

Fish and worms that build their homes

Although many reef-dwellers hide away in the numerous crevices in the reefs, a few construct their own burrows. Among burrowing fish, the little jawfish are perhaps the most methodical diggers. They bring forth small loads of sand and gravel from their burrows in their big mouths, spew this out a short distance away and return for the next load. In this operation they are sometimes assisted by a pair of little alpheid snapping shrimps whose presence in the burrow is tolerated by the fish. Using its flattened larger claw, the shrimp pushes sand ahead of itself like a small bulldozer while the fish removes the larger particles. Should two jawfish set up burrowing operations near each other, as sometimes happens, each may be seen methodically ejecting sand, a considerable amount of which slides down the other's hole. This exchange of sand may continue for some time, each jawfish seemingly unaware of its futility.

Most jawfish rest with their heads at the entrances of their burrows when not occupied in digging, watching for food and gaping with their jaws in a defensive reaction when another fish approaches too close. Our

Bright orange *Tubastrea tenuilamellosa* coral extends a 1.5-inch polyp to feed only at night. In daytime polyp disappears completely into an orange cup about half an inch high.

Moray eel goes nighttime hunting. This one has crushing teeth that attack mollusks and crustaceans. By day it sleeps in a hole with head out, always gaping to push water through gills.

picture (lower right) shows the small pastel blue-and-gold yellowhead jawfish of the Bahamas and the Florida keys. It has the habit of hovering directly above its hole, slowly sinking into it tailfirst when disturbed. Interestingly the snout of this fish is bent slightly downward, and its eyes are oriented so as to remain horizontal when the fish assumes its normal head-upward, tail-downward position.

Among the members of the reef community are many kinds of worms—although some of the animals commonly termed worms because of their shape belong to other animal groups. (For instance, the shipworm, which burrows into waterlogged wood, is really a mollusk that uses its vestigial shell as a drilling tool.) Many kinds of true segmented worms move about freely, whereas others live in limey or parchment-like tubes, which they secrete for their protection.

Some of these tube-living worm species extend flower-like or plume-like tentacles, often brightly colored, from their sheaths to strain plankton from the water as food. When touched or otherwise disturbed, they vanish instantly and seek safety in the tube. The Christmas-tree worm, a type of sabellid, has tiered whorls of feathery branches. It closes the tube with a calcareous (hard and bonelike) plug called an operculum when it retracts, only to raise this cover and reappear moments later after danger has passed. Other, larger species bear a remarkable similarity to feather dusters, and one form, which lives in holes in dead coral heads along the Florida keys, is a brilliant lemon yellow.

Strange relations among species occur on the reef. One of the most interesting involves a sea anemone, a small shrimp and a number of fish species. The little glassy "cleaner" shrimp of the genus *Paracimentes* normally rests on the tentacles of the large West Indies anemone *Condylactis* where the weak stinging power

Timid yellowhead jawfish make burrows in sand, reinforcing them with pebbles and shell. Seeking passing food above their holes, they can back or dive in when harm approaches.

Christmas-tree worms. Feeding and breathing trees are extended at top, withdrawn in center and partially exposed below. Calcareous tube, cover and spike offer protection.

of the anemone protects it from harm. Marked with spots and rings of white, blue, violet and red, the tiny shrimp is so transparent that in the photograph (opposite) one can look through its body and see the underside of the spots on the far side of the shrimp. Sometimes a fish swims alongside the anemone and intentionally comes to rest. Then the cleaner shrimp leaves the anemone temporarily and starts crawling over the fish's body, removing and eating parasites, dead bits of tissue and other debris, sometimes entering the mouth and gill chamber of the fish. The fish submits to this activity quietly, although any of the shrimp's plain-colored close relatives would be quickly captured and eaten in similar circumstances.

A larger shrimp, *Stenopus,* known as the "barber-shop shrimp" because of the broad red bands that decorate its white body and appendages, performs similar services although it lives (usually in pairs) in a sheltered place in the coral instead of on an anemone. Apparently the distinctive colors of this and the former shrimp serve as a billboard to the fish and advertise their profession as cleaners.

Cleaners are to be found among the fish themselves. In the West Indies and the lower Florida reefs are the neon gobies named for the broad blue, white or yellowish irridescent bands that run along their sides. The gobies rest on coral heads in pairs or small groups with their distinctive colors signaling "cleaning station" to other fish. These stations are visited by many of the other reef fish on a regular schedule; sometimes fish actually appear to line up awaiting their turns to be serviced. The slender inch-and-a-half-long gobies swarm over the body of a larger fish, picking up parasites and dead tissue and, as does the cleaner shrimp, going inside the fish's open mouth and often leaving by way of the gills.

Although there are no neon gobies known from the

Worm bouquet of orange and white sabellids, which live in groups. "Flowers" can be withdrawn into parchment tubes, which enclose typical segmented bodies of the worms.

For mutual benefit anemones tolerate shrimps. The anemone stingers do not attack this cleaner and parasite picker although they could kill small potential predators.

Cleaning gobies sit on a brain coral, their service station. They remove parasites from larger predatory fish, which, in exchange, do not molest the gobies.

Pacific Ocean, their ecological place is taken by little cleaner wrasses which are, in shape and coloration, almost identical to the Atlantic gobies. There is also a species of blenny fish (genus *Dasson)* in the Pacific that mimics the wrasses and so is welcomed by the larger fish; yet its activities are quite different. Armed with a pair of tusklike lower teeth, the blenny tears at the scales and fins of the cleanee, which apparently suffers the damage without realizing that it has been taken by this deception.

The variation one can find among fish is also apparent among the invertebrate groups that abound on the reefs. They include the echinoderms, which collectively contain the crinoids, sea cucumbers, sea biscuits, sea urchins, starfish and brittle stars. Nearly all of them have one thing in common: They are radially symmetrical; that is, they have the symmetry of a wheel. Yet despite their superficial resemblance to a life form low on the animal scale, their embryological development gives indications that they are actually a side branch of the main evolutionary stem that eventually produced the higher vertebrates.

Many of the echinoderms (for example, starfish and sea urchins) move about slowly on tube feet that have tiny suction cups operated by a complex hydraulic system. Water is taken into an internal capillary system through a porous filter plate and shunted to the tube feet as required by a series of tiny muscular bulbs and valves. And although most individual echinoderms may look superficially the same from all sides, they definitely have a forward end marking the direction in which they travel.

One echinoderm, the coral-eating crown-of-thorns starfish of the Pacific, has recently undergone a population explosion [see SMITHSONIAN April 1970] and become a serious pest, but most of the remainder of this group literally and figuratively occupy useful ecological niches in the reef economy.

The most primitive of the echinoderms are the crinoids, or sea lillies, which until the late 19th century were thought to be long extinct, having been found as fossils in the rocks dating back nearly 700 million years. They were first "rediscovered" by the British research vessel *Challenger* which dredged living crinoids from the sea floor. Since that time many new species have come to light.

The more primitive crinoids, mainly the deep-sea forms, live attached to permanent stalks arising from the sea floor, and a number of the reef crinoids eventually detach themselves from their stalks and swim about with their five pairs of plumed arms, occasionally coming to rest on a ringlet of small grappling hooks, called cirri, attached to their base. Known as feather stars, the free-living crinoids are variously and often brightly colored.

Superficially somewhat like the crinoids in appearance but actually far removed from them by relationship, the brittle stars have five (sometimes six) arms. These are unusually supple, allowing the animals to move about with an agility that is impossible for the

average echinoderm. A few brittle stars carry in their skins colonies of luminescent bacteria that give off a bright glow at night. In some manner the brittle star is able to trigger off the luminescence of the bacteria in such a way that in several species short bands of light travel along each arm from its base to the tip whenever the brittle star is disturbed.

Brittle stars are most active at night when they slide about the sea floor in search of food, hiding away in sheltered places during the day. One favorite resting place for certain species is shown in our last picture: within the hollows of organpipe sponges, where the animals may sometimes rest with their arms draped over the edge of the sheltering tube, perhaps being benefited by the water currents that are expelled through the "mouths" of the sponge.

No single article can discuss more than a small part of the story of the reef community with its myriad colorful life forms. Much still remains to be discovered, and, as scientists continue to piece together fragments of knowledge, we hope that in some way this knowledge will contribute to the steadily growing interest that man as a whole is gaining for the ecology of land and sea. More important is the preservation of the environment by whatever means; man himself is ultimately dependent on the various life forms that inhabit his planet just as these other life forms depend on each other for survival.

Crinoid fans its arms so that each of the little branches ("pinnules") is perpendicular to the current from which it catches food.

Sponge (opposite page) is a daytime lounging place for brittle stars and permanent home for tiny yellow anemones on its surface.

Oil men hit water: Libya's new desert wealth

With the profits from petroleum, a U.S. company taps a big unsuspected source and shows farmers how to use it

Tumbling around the feet of a Libyan farmer and his son, at an oasis far out in the barren Sahara, is a gusher that symbolizes a most exciting discovery. Water—clean, sweet water—spouts from wells driven from 350 to 2,700 feet deep, plumbing an immense subterranean layer of water-bearing rock that may stretch for hundreds of square miles beneath the desolate expanse of desert. Hydrologists believe the giant aquifer contains water equal to the flow of the Nile for 200 years, or the contents of all five of the U.S. Great Lakes, or—more importantly—enough to irrigate 200,000 acres for several centuries.

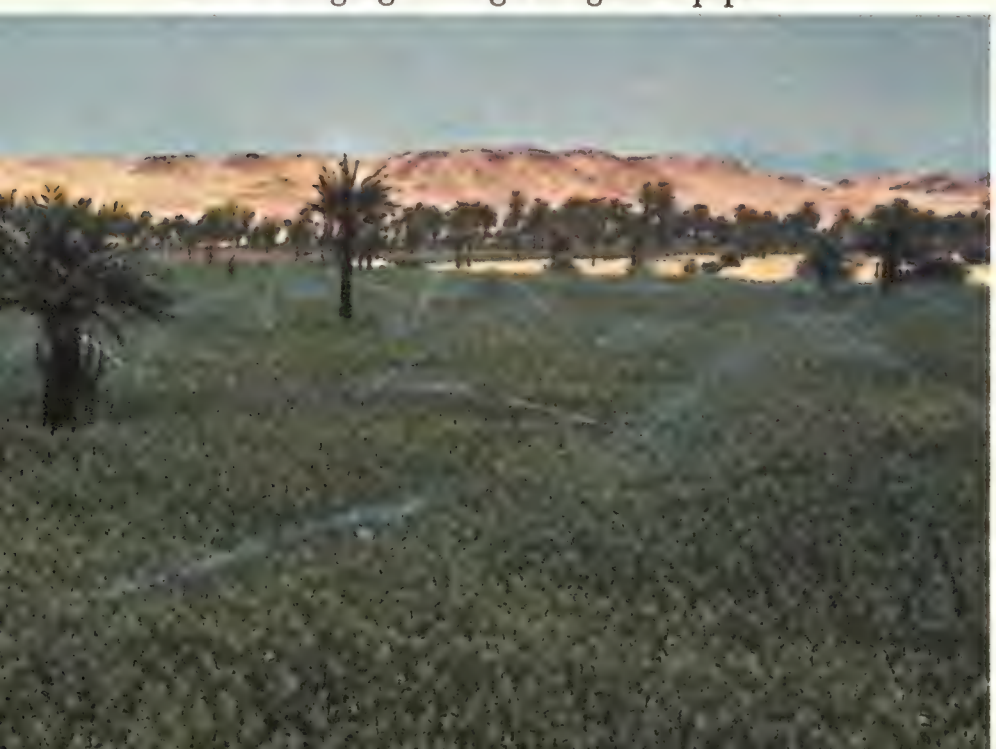
The discovery is just two years old; it has the surprised Libyans trying to understand its potential for large-scale agriculture but also its possible effect on the nation's entire economy.

How the modern dowsers found this bonanza is a story of cooperation between the Libyan government and an American oil firm. Though Libya's coffers jingle with oil money from the boom that began a decade ago, the nation is chronically short of food. More than twice as big as Texas and inhabited by less than two million people, Libya has two slender coastal strips where agriculture flourishes and must import meat and many staples to feed its population.

When Occidental Petroleum Corporation of California applied in 1966 for oil concessions, its chairman of the Board, Dr. Armand Hammer, added an offer that held special appeal for the Libyan government: He promised to devote five percent of the oil profits to

Libyan farmer plays with his son in man-made lake, a luxury provided by Kufra's first deep well.

Powerful pumps bring up the deep-well water and send it surging through irrigation pipes.



Libya's agriculture—especially to a search for water. Libya agreed. Occidental struck oil quickly and then kept its promise. In May 1967, it brought to Libya a team of agricultural consultants who studied all available geological surveys, toured desert areas, and summed up by suggesting that Occidental drill for water at an ancient site 850 miles southeast of Tripoli —the oasis called Kufra.

The Libyans always knew there was some water at Kufra. For thousands of years its struggling date palms and tiny thumbprints of greenery had risen over monotonous desert horizons to welcome camel caravans on the thousand-mile trek from Chad and the Sudan to the coastal Mediterranean ports. While camels quenched their thirst and rested, drivers filled their waterbags from Kufra's hundreds of shallow wells.

In an area where there is no annual rainfall—it last rained for one day in 1943—fruit trees and vegetables were sparse. Since World War II, many dispirited farmers had moved away to more fertile regions in Chad. But in the past two years, Occidental has effected its miracle. Hauling a drilling rig across 400 miles of empty desert, Occidental began in the summer of 1968 to drill in El Jowf, a core village of Kufra's scattered communities. Boring down through moist sand, the bit struck a spongy rock formation and the first well was soon flowing. Since then nine other deep wells (and 11 observation wells) have been sunk and are producing water at rates of up to 3,500 gallons per minute. The aquifer is thought to reach east into Egypt and the Sudan and south to Chad; it is fossil water, dating to 15,000 years ago when Saharan rainfall was heavier.

Tiny plots thrive on new diet

Within Kufra the water was first channeled to the existing tiny farms of 20 local farmers who volunteered their cooperation and allowed Occidental's experimenters to plant small test plots alongside their own crops. Using soluble fertilizers in the water and introducing newer seeds and disease-resistant plants, Occidental's men soon had 60 acres of farmland producing abundantly. Wide-eyed, the Libyans watched their melons, squash, eggplant, wheat, barley, beans and millet—the "rice" of the desert dweller—thriving on the new diet.

Kufra is now becoming self-sufficient in foods but still imports flour and barley. Its domestic animals—sheep, goats, donkeys—have fattened swiftly as year-round forage supplies became available. Olive and most of the fruit trees are doing well (34 varieties of grapes are on trial); the date palms bear heavy loads in season; most of the farmland can now be concentrated on crops of wheat, barley and Berseem clover.

But, with this minuscule example of how the desert could be made to bloom, it soon became obvious that more ambitious plans could better serve Libya.

Occidental's man-on-the-scene, Leo L. Anderson, director of the agricultural project, moved faster. Requesting an experimental plot of wasteland, he obtained 600 acres six miles from Kufra in open desert. The soil was totally infertile, "about like ground-up bottles," says Anderson. He laid 50 miles of irrigation pipe, inserted soluble fertilizers into the water, broke and tilled the packed, dense surface and seeded alfalfa, Sudan grass and 15 other test crops. Five deep wells (and one standby) have been drilled in this test area and all are producing steadily.

The next goal is a large-scale commercial farm. Libya is short of labor and manpower, and the chance that hundreds of family-operated farms could yield sufficient foodstuffs was unlikely. Beside that, the unbroken stretches of level landscape surrounding Kufra invite modern machinery for planting and harvesting —seeders, mowers, balers and stackers can roll across these level plains as they do in the U.S. midwest.

The first full year of production, 1969, showed spectacular results. Lush alfalfa yields eight tons of hay per acre; Berseem clover, never grown before on desert land, averages 50 tons green weight per acre; Sudan grass produces 20 tons of hay per season. Even more spectacular is barley—now producing as much as 125 bushels per acre—the highest such yield known anywhere in the world.

The venture has been costly. Occidental, advancing its own funds against future oil profits, spent $325,000 to drag drilling equipment across the miles of empty desert, and in addition had to set up communications, living quarters, transport and weekly air flights from Tripoli to Kufra. Foreign technicians of several nationalities are employed to supervise and train Libyans, but Libyans are providing the main labor force which lays and moves pipe, plants and harvests.

Since forage for animals is its primary product, the commercial farm's next objective is turning its grain and hay into meat. At present, live animals, sheep and other meat products are being imported at a yearly cost of $20 million, and Libyans often can only afford goat or camel. Anderson hopes to introduce a breeding flock of sheep by bringing 10,000 ewes to Kufra. In time, meat may be exported not merely to the populated regions of northern Libya but to other meat-short countries of the Middle East. As Dr. Hammer says, "bringing modern agricultural skills and techniques will provide additional prosperity to the Libyan people in the years ahead."

Vast new test plot set aside

That Libya intends to find solutions is evidenced by its continuation of its agreement with Occidental after the change of government in the coup last September. Tens of thousands of additional acres have been set aside in the desert for future development, and the government has promised to diversify and expand all of its agricultural activities.

What Anderson calls "a spark of enthusiasm and optimism" has lighted Kufran faces. He sees "men who have harvested crops with a sickle in the past now learning to use combines and tractors." And, "caravan drivers, whose families have been coming to Kufra from the Sudan and Chad for centuries, are carrying news of Kufra's miracle back to their homelands."

But, to the officials who drop in by air, the vivid green rectangle leaping to the eye amid hundreds of miles of monotonous sand must seem even more startling and promising. It is a reminder that Libya, in ages past the granary of Greece and Rome, may find water—not oil—its fountain of wealth.

—*Mary H. Cadwalader*

Against desert background, mechanical harvester (below) rapidly cuts spread of Sudan grass.

Aerial view of Occidental's giant farm project
in the desert shows lush rectangle of crops,
with technicians' camp and well in foreground.

Restoring life to aging art

How do you keep a 500-year-old Japanese painting alive and well? It helps to have some 1,000 years of experience behind you

Takashi Sugiura is a member of one of the most select companies of artisans—artists, if you will—in the world. He is a Fellow of the Japanese National Treasures Restorers Association. There are only five other Fellows, and they are all in Japan. But Mr. Sugiura practices his craft in Washington at the Freer Gallery of Art, one of the museums in the Smithsonian complex.

He works in a large, light-filled studio with straw matting on the floor. There, with the help of three assistants, he cleans, preserves, restores and, in general, broods over the condition of the Chinese and Japanese

To begin restoration, the painted surface is lifted from each panel of the screen.

Shigero Mikkaichi strips layers of paper padding (in this case, old letters) from the core.

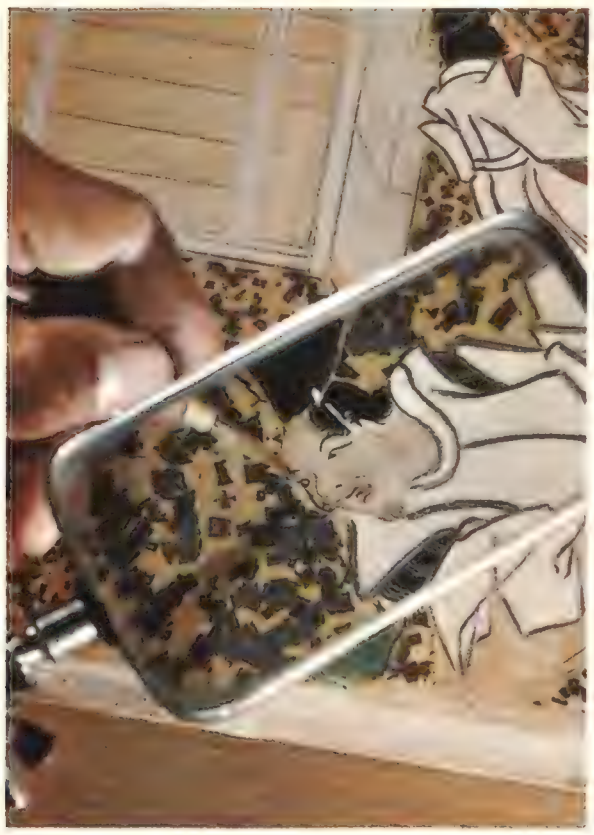
After removal, most paintings are washed with a spray in a specially designed sink.

Mr. Sugiura retouches a panel while his assistants prepare new cores. Behind them is a pair of screens by the famous 15th-century painter Sesshu.

paintings in the Freer's great collections of Oriental art, a delicate and exacting business that employs techniques first developed about 1,000 years ago. These techniques are perhaps most fully demonstrated in the conservation and restoration of Japanese screens, as shown in these pages.

The Japanese screen is a wonderfully efficient combination of beauty and utility. Its present format was evolved during the Momoyama period (1573-1615), when the tea ceremony and many other rituals were also hardening into changeless tradition. There are usually two or six leaves, held together by double hinges that permit them to be folded either way, and they often come in pairs.

The screens are made of many layers of paper pasted over a wooden grid that combines rigidity with lightness—an important quality because the function of a screen is to serve as a temporary, and therefore necessarily portable, partition. The top layer is a painting executed on silk or on a smooth, tough paper made of mulberry bark or bamboo. (Among westerners the idea of "rice paper" as a vehicle for Japanese art dies hard, but although the Japanese have many exquisite pa-



Damaged areas are retouched. The black spots are flakes of silver foil, now tarnished.

Several layers of new paper are pasted to the core to serve as a cushion for the painting.

A border of paper-backed silk is applied with a thin film of paste and a small electric iron.

Trying out silks, Kumi Kinoshita unrolls a modern design. The others are traditional patterns.

pers, none is made from rice straw.) The adhesive used is always a water-soluble flour paste, so that the whole thing can be taken apart, patched up, and put together again whenever it becomes necessary.

This is exactly what Mr. Sugiura does in his studio, with the help of an assistant, Shigero Mikkaichi, an experienced restorer who joined him last September; an apprentice, Makoto Souta; and his daughter, Mrs. George Kinoshita. All of their papers, paints, brushes and silks are imported from Japan, but the paste is cooked in the studio, a new batch every week.

The painstaking process required to restore a pair of six-panel screens takes from three to six months. To begin with, the painting is carefully lifted from each panel and washed (if the paint is waterproof). Old repairs, pasted on in previous restorations, are peeled off and other damaged areas are cut away, often leaving a very blotchy-looking piece of art. New patches are applied, along with a coat of animal glue and alum—it is called *dosa*—to seal the surface. The painting is then retouched in the style of the artist and the period with the aid of a light-backed magnifying glass. In the meantime, the layers of paper padding are stripped from the wooden core. If the core is in bad condition, it is replaced with a new one made in the Gallery's carpentry shop. Then the process is reversed: layers of fresh paper are pasted down, the painting is reapplied, and each panel is finished off with a border of silk brocade.

Visitors who come to Washington each spring to see the fugitive display of Japanese cherry blossoms will find in the Freer a few blocks away far more permanent reminders of the peculiar genius of Japanese civilization. Among them are masterpieces of painting, which —thanks to Mr. Sugiura and his staff—are kept as fresh and immaculate as the blossoms outside.

Newly cleaned and remounted, this screen painted in the 1660s will have its molding replaced.

The Crab as photographed today from the earth.
It is a vast and rapidly expanding gas
cloud, emitting radio waves, visible light and
x rays, powered by a spinning neutron star.

By Stephen P. Maran

In nine centuries, search unravels many parts of the Crab Nebula mystery

After a bright star blazed, astronomers needed telescopes, rockets, antennas and speculation to help them explain it

Shortly before dawn on a July morning nine centuries ago, the Chinese astronomer Yang Wei–Tê glanced at a brilliant yellow star in the east, where day would soon break over Khaifêng, capital of the Sung dynasty. But this star did not belong there! The map of the constellations was very clear on this point, and the Chinese astronomers did not make mistakes in such matters. During nearly 1,300 years, they had unfailingly recorded all 17 appearances of the comet that, much later, would be named for Edmund Halley.

Yang's new star was as bright as the planet Venus, which outshines everything in the sky except the sun and moon. In fact, when the sun did rise, Yang found the star still visible. Although it soon began to fade, he reported that it could be seen in broad daylight for more than three weeks. After that it remained perceptible among the stars for some 600 nights. Then finally it passed beyond the limits of vision.

Astronomers in Peking and Japan recorded the star too, and so, we think, did North American Indians. At least they made drawings of a big round object near a crescent moon, and computations show that they probably were picturing the same event.

Yang may not have known of these other observations, but he did know his politics. His position as chief computer of the calendar gave him access to high authorities of the imperial court, before whom he was soon prostrated, begging leave to report the occurrence of the "guest star." The star, Yang explained, was an indication of the greatness of the present emperor. This explanation was favorably received, and the Bureau of Historiography was instructed to record Yang's report for posterity. Thus was documented the first clue in the tale of the Crab Nebula (opposite page), which has become an outstanding detective story of modern science.

In 1054 when Yang saw his star no one knew of nebulas—those spots of light in the sky that look like glowing clouds through a telescope. There was therefore no Crab Nebula mystery—just the first of many clues to a riddle that would develop as men studied the skies through the centuries. Like all good scientific problems, this riddle is open ended. Each new answer to some part of it suggests new questions. Yet in the last two years we have managed to explain a lot about the Crab Nebula. We know now that it was born when a great star larger than our sun exhausted its nuclear fuel and collapsed. As the stellar matter condensed towards the center, gravitational force upon it increased tremendously. The pressure rose so high that the individual atoms themselves collapsed; their constituent negative electrons and positive protons combined to form electrically neutral particles, neutrons. As the star collapsed, it spun ever faster.

A by-product of the great implosion was a splash. While most of the matter was drawing together in the star, some was flung out into surrounding space. It persists there as a rapidly expanding cloud of gas.

Electrons from the spinning star pass out into this gas cloud. Encountering magnetic fields, they release energy as radio waves, visible light and x rays. Here on earth we can detect this radiation, and it allows us now

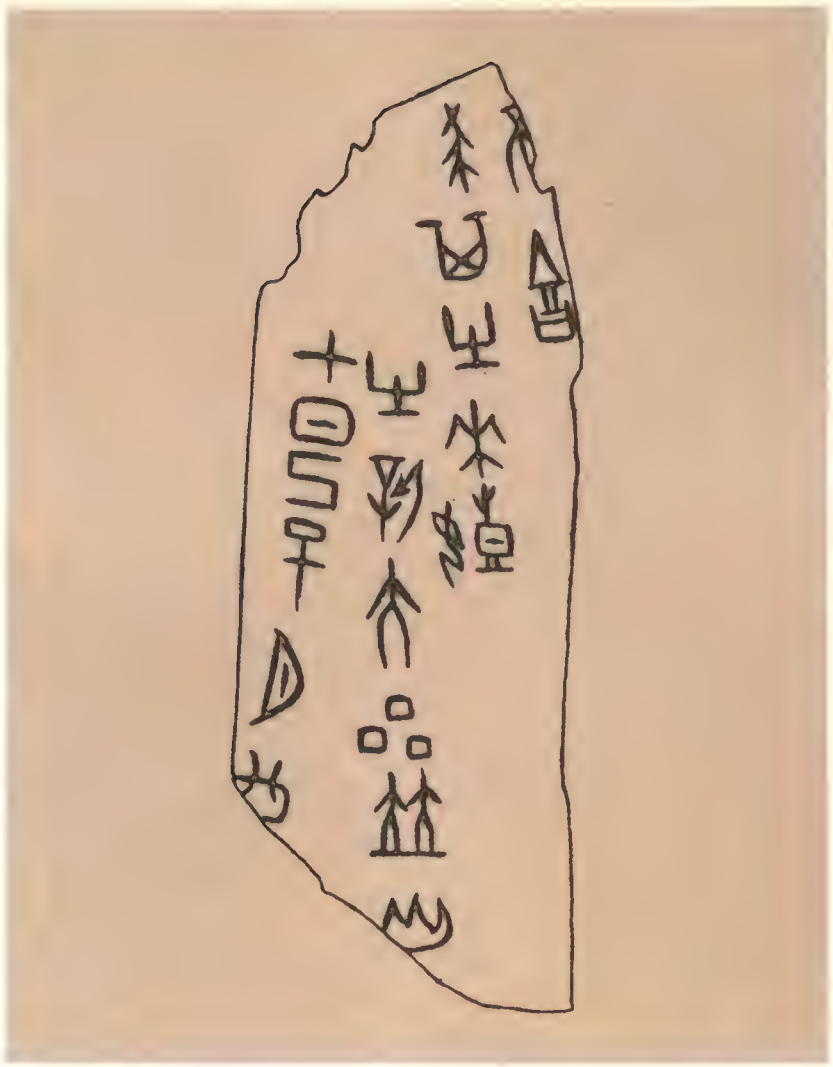
Astronomer Maran, project scientist for orbiting solar observatories at NASA's Goddard Center, goes to mountaintops in Chile and Arizona to study skies. The opinions here are his own.

to understand this great, glowing, expanding gas cloud powered by a giant flywheel at the center. But the first step to follow Yang's sighting was relatively simple: Someone had to *find* the nebula.

After Yang's "guest star" faded beyond his view, no further clues presented themselves until 1731. By then telescopes were in fairly wide use and one belonged to an English doctor and amateur astronomer, John Bevis. Wholly unaware of the Chinese observations, Bevis happened to point his telescope at the same place where Yang's brilliant star had appeared and found the second clue. He saw not a dim, pointlike star but a fuzzy patch of light—in fact a "nebula."

Still another century later, in the mid-1840s, at Birr, Ireland, the third Earl of Rosse examined Bevis' nebula with the largest telescope the world had seen; its big mirror measured six feet across. He discerned clue three—filaments in the patch. Rosse's drawing of what he saw has been compared to a picture of a bug. He chose to call it a "Crab," and so the nebula was christened.

By the last decade of the 19th century, astronomical technology had so improved that the nebula could be photographed. In 1921 John Duncan of the Mount Wilson Observatory in California compared two photographs of the Crab taken 11½ years apart, using the 60-inch telescope in the San Gabriel Mountains. On the more recent picture the filaments were a trifle farther from the center of the nebula than on the earlier exposure. This showed that the Crab was *expanding*. Duncan's finding, fully confirmed by other astronomers and measurement techniques, was the fourth great clue in the story: Where a star once flared briefly, a cloud of shining gas, six light years in diameter, was expanding into space at the rate of almost 700 miles per second. For comparison, the "escape velocity" that an Apollo spacecraft must attain to leave the earth on



First report of a nova made by Chinese about 1300 B.C. Their followers recorded the 1054 supernova that gave birth to the Crab Nebula.

This drawing from Indian ruins in Navaho Canyon, Arizona, has been interpreted, along with another found in a cave, as the 1054 supernova.

Definitions of terms used in article

constellation any one of about 88 groups of the fixed stars (as seen from the earth) used to define areas of the sky. Stars in a constellation may not actually be close together in space.

electron one of three fundamental particles (with neutron and proton) making up atoms. It has a negative charge and makes up the outer part which contains almost all the volume of an atom but only a tiny fraction of its mass.

escape velocity the speed an object must attain to escape (without further propulsion) from the gravitational field of a planet or other body.

galaxy a collection of billions of stars and various objects among them held together by gravity. An example is our own galaxy, the Milky Way, of which the Crab Nebula is a small part.

light-year the distance through which light, moving through empty space at 186,000 miles per second, travels in a year—5,878 billion miles.

Milky Way the galaxy of which our solar system is a part.

nebula a gas and dust cloud in the heavens. A few are bright and look like fuzzy stars to the unaided eye; some are dark and observable only as black patches against a starry background.

neutron one of three fundamental particles (with electron and proton) of which atoms are made. It has no charge and occurs in the nucleus.

neutron star a star in which gravity has compressed all matter into a volume so tiny that atoms have been crushed and made into neutrons.

proton one of three fundamental particles (with electron and neutron) of which atoms are made. It has a positive electric charge and is a constituent of the nucleus.

pulsar an object in the heavens that emits pulses of radiation at a regular rate between 30 times a second and once every 3.7 seconds. Pulsars are a recent discovery and have been identified as neutron stars.

solar system our own sun and objects orbiting about it including planets, asteroids, meteors, comets.

supernova a star in the act of a great explosion that follows exhaustion of its nuclear fuel.

a lunar excursion is a paltry seven miles per second.

Distance dims the brightness of any light. We know now that the Crab Nebula is—and Yang's star was—some 6,000 light-years or 35,000,000 billion miles from the earth, whereas Venus, even at the most distant part of its orbit, is about 160 million miles away. Yet to Yang it seemed that the star was fully as bright as Venus. Considering that dust in space also dims the light of distant objects, the true brightness of Yang's star must have equaled the combined luminosity of at least 200 million suns.

A stellar outburst of this fantastic magnitude is a rare phenomenon indeed. In a spiral galaxy or "island universe" (so-called because it is a self-contained star system) such as our own Milky Way of some hundred billion stars, it will occur at most three times in a century. Astronomers call such an event a "supernova" and identify it with the death throes that occur when a massive star burns itself out.

The contemporary astronomer Hong-Yee Chiu has compared this process to a fire in a tile-roofed, wooden house: When the burning walls are nearly consumed, the roof falls in, and its impact causes one last splash of flame. In the same way, when the star exhausts its nuclear fuel, the exterior portion collapses, causing a great thermonuclear explosion. The tremendous brightness of Yang's star and the great speed of the expanding gas in the Crab show that the nebula is the result of a supernova.

What happens in a supernova outburst? During the 1930s, two famous physicists, Lev D. Landau in the Soviet Union and Robert Oppenheimer, in collaboration with G. M. Volkoff, in the United States, speculated about a new state of matter—and a new kind of star. You would get a "neutron star" if somehow you could take all the matter of a star like the sun (diameter 864,000 miles) and squeeze it into a ball just 10 miles across. The matter would then be as dense as the nucleus of an atom; a small matchbox would contain as much material as 17 trillion quarts of water. Heavy stuff indeed! If that same matchbox-sized chunk of neutron star could be "canned" and dropped on the earth, it would go right through as if a housewife dropped her steam iron through a wet Kleenex stretched on a hoop.

The most likely possibility for such a compression was that same collapse of a massive star that makes a supernova explosion. Theory suggested that the explosion might actually be the side effect of the *implosion*. A fraction of the star's mass would splash off as an expanding nebula, but most of it would remain in the tiny neutron star. Many physicists did not agree, however. So the concept of neutron stars, once raised, was soon neglected, until revived in the late 1950s by a few true believers.

Three more clues to the riddle of the Crab appeared as astronomers discovered and studied its strange radiations. The nebula was one of the principal objects of interest in the early history of *radio* astronomy. In 1948, John G. Bolton, using antennas atop a 400-foot cliff on the Australian coast near Sydney, detected radio waves from the constellation Taurus in which

The big bowl at Arecibo, Puerto Rico, a radio telescope, explored pulsars after Cambridge astronomers had announced their existence.

one finds the Crab. In the following year, Bolton and associates took more refined observations and pinned the "Taurus A" radio source down to the Crab Nebula. This work in Australia predated construction of the "big dish" radio telescopes that are a familiar part of modern observatories and tracking stations. In fact the Crab was the first radio source identified with an object outside the solar system.

The Australian radio astronomers realized an incredible implication of their measurements. It had been known that stars and other natural objects emitted radiation by thermal processes; that is, the kind of radiation depended on the temperature of the object. Picture glowing molten iron fresh from the blast furnace. At first blue or white hot, it turns red as it cools. If you measure the color you get a direct indication of the temperature. In like manner, the colors of the stars indicate their surface temperatures, and these "color temperatures" have been verified by several techniques.

It was natural, therefore, to apply the theory of thermal processes to the radio measurements of the Crab. But the great strength of the radio signals implied a temperature of *two million degrees*. The Australians pointed out that this could not be reconciled with the much lower temperature indicated by the visible light of the nebula. This conclusion was clue number five. Perhaps some strange process, unlike those present in the stars, was at work in the Crab.

Then came the development of x-ray astronomy. Our atmosphere prevents x rays from reaching our planet. But after World War II, rockets could lift devices above the atmosphere to detect these radiations. The detectors found a previously unknown x-ray source somewhere near the Crab. The early instruments could not pinpoint the source, so its association with the nebula was uncertain. But in 1964, the celestial stage was set for a brilliant experiment, conceived by Herbert Friedman and his co-workers at the Naval Research Laboratory. On July 7, the moon was due to pass in front of the Crab. Friedman timed a launch so that the rocket would be aloft during this event, known as an "occultation."

Results of the occultation experiment, clue six, were conclusive: As the edge of the moon passed in front of the nebula, the x-ray signal faded out. This fading demonstrated that the Crab is a powerful source of x rays; it is presently known as the strongest such source in our galaxy. The same experiment also proved that the x rays come from an extended region in space, not just from a star. If the x rays were emitted by a star, they would have vanished quickly as the moon's edge occulted their source. Instead, they slowly faded as the moon passed across a region about two light-years in extent at the center of the nebula.

Clue number seven was the 1953 discovery that the visible light from the Crab was like light that comes out of electron synchrotrons—devices with doughnut-shaped chambers for accelerating electrons with which to bombard atomic nuclei. Scientists at the General

Electric Company got one going in 1947, and when they looked through a window into the cavity containing the electron beam, they saw a strange light. When they studied it through a Polaroid filter, they found that this "synchrotron radiation" was polarized. Rotating the filter blanked it out.

A Soviet astrophysicist, I. S. Shklovsky suggested that the Crab was radiating like an accelerator. Its fast electrons were emitting synchrotron radiation.

The Russian theory, dubbed the "synchrotron model," proposed that relatively slow-moving electrons produced the nebula's radio emission while faster ones contributed to its visible light. There was one obvious consequence of this theory: The light from the Crab Nebula, like that from the G.E. synchrotron, should fade as the observer rotated his Polaroid filter. Later in 1953 this prediction was fully confirmed.

There was, however, one serious flaw to the synchrotron model theory. It very nicely accounted for the properties of the radio and light waves from the Crab. And later it explained x rays and infrared radiation from the nebula. But fast-moving particles that lose energy to synchrotron radiation slow down rapidly. The most energetic electrons, which produce x rays, should die out in less than a year. *They could not possibly have lasted since an explosion seen in 1054.*

This stumbling block in the theoretical explanation of the nebular radiation turned out to be a vital clue (number eight) in the story. Some unknown object or mechanism must supply these particles continuously.

Strange pulses from the sky

By the late 1960s, radio astronomy had come of age and a surprising discovery in 1968 supplied the last two clues—so far. A general catalog of radio sources listed nearly 1,300 celestial emitters. An "antenna farm" of the National Radio Astronomy Observatory continuously monitored the sky from Green Bank, West Virginia. Jodrell Bank, the great radio observatory in England, was virtually a household word. Radio waves had been recorded from many sources. Perhaps the most common attribute of these radio sources was their continuous output at radio frequencies. But the announcement in 1968 of a cosmic radio source that "beeped" at intervals of about 1.337 seconds, repeating with a precision of better than a hundred thousandth of one percent, astonished the scientific community.

This "pulsar" was reported by Antony Hewish and his Cambridge University associates in the February 24 issue of *Nature*. Two years later, 50 pulsars are known and more than 400 articles about them have appeared in technical journals. The property that distinguishes pulsars from every other sort of natural object is their repetitive emission of regular short pulses. So extreme is the regularity of the pulses that they suggest man-made radar and the telemetry beeps of the early Soviet Sputniks. Half humorously, the Cambridge discoverers named the first pulsar "LGM-1" for "Little Green Men."

The Cambridge astronomers were very quiet about pulsars from the moment of discovery to the publication of it in *Nature*. Such an announcement had to be very carefully checked before being published. They also knew that once the existence of pulsars was revealed, American scientists operating a 1,000-foot bowl-shaped radio antenna cradled among the hills at Arecibo, Puerto Rico, would be much better able to explore them than could the British with the sophisticated, but less sensitive, equipment at Cambridge. At last, though, they had refined and confirmed their observations, and the announcement gave Arecibo its chance.

Extensive investigations by many astronomers, notably Frank Drake's Arecibo group, established the basic properties of the pulsed radio sources, showing among other things that these pulses were *not* pro-

duced by intelligent life. On the other hand (as Drake told the National Academy of Sciences) "stupid life" might not be excluded.

Physicists stretched their imaginations further to explain pulsars. Clearly, their first task was to uncover the "clock mechanism." In other words, what celestial process spaced the pulses so perfectly that they rivaled the best man-made clocks? There were three basic explanations: vibration, rotation and orbital motion. A star might vibrate at a precise rate like a tuning fork or bell, producing a pulse at each vibration.

The rotation theory, on the other hand, would ascribe the pulsar radiation to a bright spot on a rapidly spinning star; as it turns past our line of sight, we perceive the bright spot as a pulse. Finally, the regular pulses could come from the orbital movements of a double star, each member whirling about the other; this idea can be compared to the annual motion of the earth around the sun.

The first group of pulsars had periods between pulses ranging from nearly two seconds down to a quarter second. Periods so short meant that pulsars are small and compact. A star like the sun cannot vibrate as rapidly as once per second and, if it spun that fast, centrifugal force would disrupt it and fling matter out into space at the stellar equator. This consideration eliminated the vibration theory. Orbital motion could be eliminated too. Calculations show that two ordinary stars cannot orbit with a one-second interval because the distance between them would have to be less than the size of the stars themselves.

Thomas Gold of Cornell University, however, suggested that pulsars were small, rapidly spinning neutron stars. Just as a figure skater with arms outstretched spins faster and faster as he brings his arms to his sides, so a supernova—a collapsing star—would rotate ever more rapidly as its particles came together to form a neutron star. It could easily reach a rate of one turn per second, or faster. Further, it would be so dense that centrifugal force could not disrupt it, and the implosion would amplify its magnetic field.

According to Gold, the end product of a supernova would be a rapidly spinning neutron star with a powerful magnetic field. Electrons, continuously streaming off a "sore spot" on the stellar surface, would travel through the magnetic field into surrounding space, generating a beam of synchrotron-like radiation. In short, a pulsar was a kind of lighthouse in the sky.

At first, Gold's idea did not attract very much attention. But at the Green Bank, West Virginia, observatory, David Staelin and E.C. Reifenstein III were hunting for new pulsars with a 300-foot antenna. They found two. One of them, promptly confirmed by the observers in Puerto Rico, was located in the Crab Nebula, beating at the tremendous rate of 30 times per second! Only a neutron star could vibrate, rotate or orbit so rapidly. The news of this discovery was soon relayed to Russia by transatlantic telephone. The American astronomers' names may not have been transliterated very accurately, however; for it is reported that an audience of physicists at Moscow University was told, "Now the Americans have a Stalin, and he has found a neutron star!"

The discovery of the neutron star in the Crab Nebula (clue nine) was unique. For the first time in astronomy a theoretical prediction for a wholly new class of objects really came true. It was too late for congratulations, however. Of the chief authors of the neutron star concept, Oppenheimer had died in February 1967, a year before the announcement of the first pulsar, and Landau, who died in the following year, had never fully recovered from severe brain damage that resulted from a 1962 accident.

A gradually slowing neutron star

Before long, the observers at Arecibo noticed a striking property of the Crab Nebula pulsar. Unlike the other pulsars, as thus far observed, the Crab did not have a precisely constant interval between pulses. In fact, accurate timings showed that the period of the Crab pulsar was lengthening by 37 billionths of a second per day. Imagine a wristwatch that erred by only that amount! Gold realized the large implications of the minuscule change. It was already accepted that the pulsar period of 1/30 second could only describe the rotation of a neutron star. Then the tiny lengthening of the pulse spacing must mean that the spinning neutron star was slowly running down. Think of this star as a giant flywheel, ten miles in diameter, set in motion by the supernova outburst, turning 30 times per second and possessing the mass of the sun. For a wheel

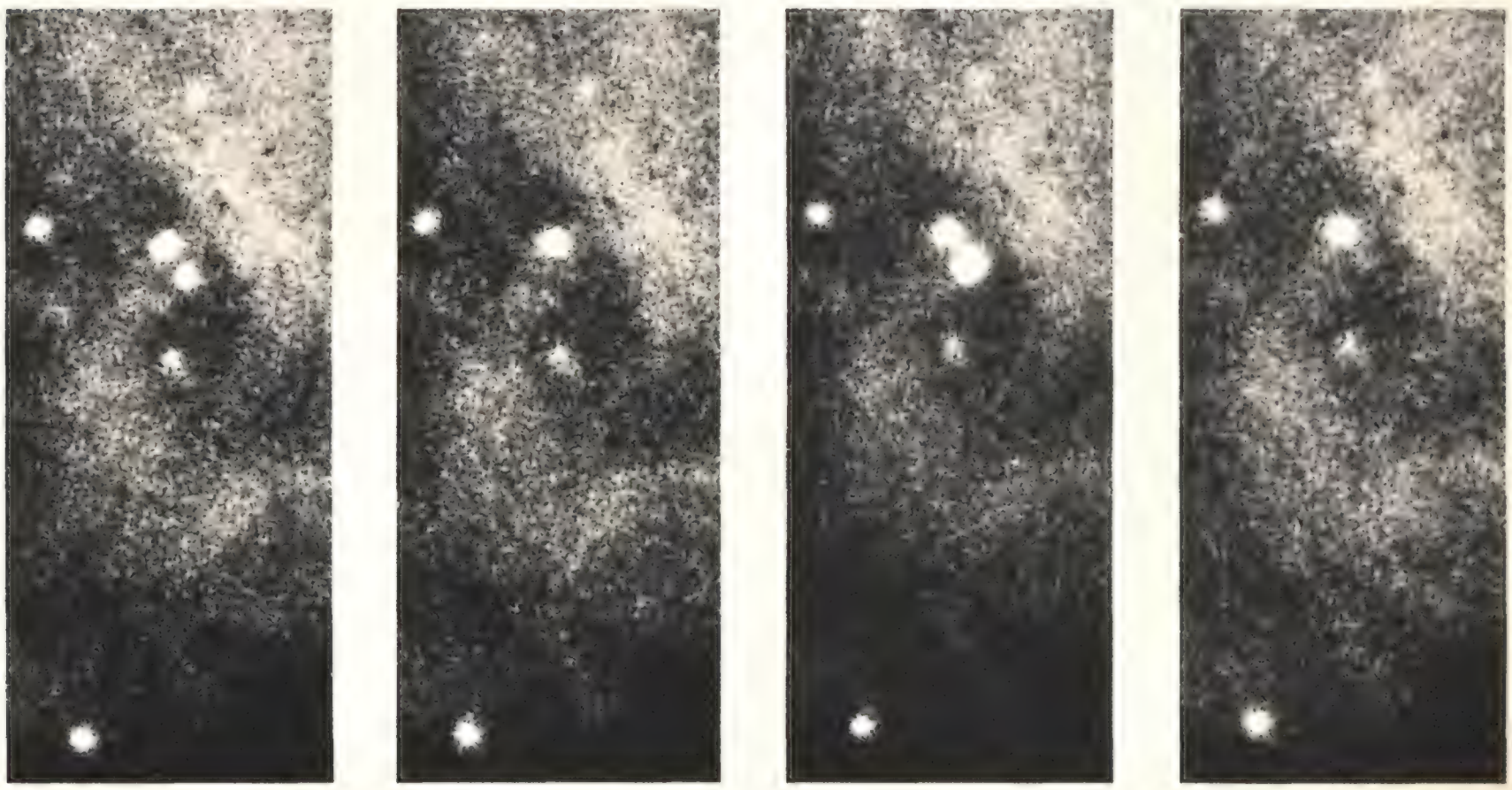
like this, a slowdown of even 37 billionths of a second per day represents an enormous loss of energy—more than enough to power the whole Crab Nebula—x rays, light, radio emission and all. The observation of a gradual slowing of the rapidly spinning neutron star was our tenth and final clue: The explosion observed in 1054 A.D. had set a cosmic flywheel spinning, and its spin is energizing the Crab Nebula today.

So this most recent astronomical discovery of the pulsars tells us the "who" of a whodunit that started with a bang and a flash seen in 1054. The flash was from a great collapse, the implosion of a star that crushed itself and its atoms under the force of its own gravity. Electrons streaming from this rotating neutron star pass out into the nebula formed by the supernova explosion, where they encounter magnetic fields and produce synchrotron radiation.

But the term "final clue" is a deliberate misnomer because future astronomers must find out much more about the Crab. Precisely *how* does the spinning, magnetized neutron star accelerate electrons to the enormous velocities required by the synchrotron theory? Just where do the radio pulses come from? Do they arise in the distant surroundings of the star, as has been suggested by Franco Pacini of the University of Rome? Or do the pulses arise at the magnetic poles on the very surface of the star?

The Crab pulsar is unique among the 50 objects of its class. Climaxing the long search for visible light from the pulsars three University of Arizona astronomers detected light pulses from the nebula, and another Friedman rocket shot found pulsed x rays as well. At the Kitt Peak National Observatory near Tucson, Roger Lynds, D.E. Trumbo and I determined that the light pulses arise from the same star in the nebular center that the Mount Wilson astronomers, Walter Baade and Rudolph Minkowski had proposed in 1942 as the most likely candidate for the remnant star of the explosion. Because the Mount Wilson photographs were long exposures, only in 1969, in the course of the pulsar studies, did we realize that (unlike all other stars) this star does not shine continuously. Special photographs (below) show that it flashes at the same rate as the radio pulses.

Why do we find no evidence for light or x rays from any pulsar but the one in the Crab? What causes the strange ripples of light that occasionally travel across the nebular gas? Do the pulsars produce the cosmic rays that pervade space, as Gold believes? What caused a recent abrupt change in the spin rate of the Crab neutron star? Was it a "starquake" or the eruption of a stellar "volcano"? It seems that we have a great deal more to learn from the Crab Nebula, and if experience since 1054 is any guide, the new facts will be developed by scientists of many nations, most of whom will be surprised by what they find.



Flashing, neutron star. A series of photographs synchronized with the radio pulse shows that the star "turns on" in visible light when radio emission is at a maximum and goes off at other times. These equally spaced pictures show the star on in first and third, off in second and fourth.

By Meryle Secrest

Bob and Judy, puppeteers

Mr.and Mrs. Brown make their magic every day at the Smithsonian simply by pulling a good many strings

Compared with the crowded floors below, the third floor of the Smithsonian's Museum of History and Technology appears almost deserted. From the escalator, you pass displays of coins and glassware and go through a computer exhibit. Then you hear it: music of Prokofiev's "Peter and the Wolf," fierce growls, a bird's voice, squeaking, "Missed me, missed me, now you've got to kiss me," people laughing.

A puppet theater is not what one would expect to find in a museum, but it works. Puppets have a lure, old as the human race, that is magically consistent.

Bob and Judy Brown, the husband and wife who run the show, don't understand the appeal and can't define it. They simply evoke it. The Smithsonian's Resident Puppet Theatre has been an instant hit since it started in a tent on the Washington Mall in 1968.

The theater consists of a full-sized open stage on two levels with a black backdrop, faced by rows of benches covered with red plush, which rise in tiers. It keeps changing because of the restless energies of the Browns. In "Peter and the Wolf" the two of them and their assistant, Bob Payne, blend in and out of the story, three live bodies bounding around the stage with their puppets. After three hours of manipulating their nearly life-sized puppets, they are drenched with sweat and exhausted.

Bob has the kind of face that animates Hans Christian Andersen fairy tales. With his curly brown hair, high-domed forehead and small neat features, he could be a Pied Piper or a magician.

Judy is short, pretty, dark and athletically built. Her mother was an Olympic gold-medal-winning swimmer who went on to become a movie stunt lady. Judy studied acting at the American Academy of Dramatic Arts in New York. But, she says, "I wasn't star struck. That was the problem. I liked acting, but I hated the things that went with it. Going to endless auditions. Begging and pleading for jobs. Also I had the problem that when I'd go down for an audition, they were such weird shows. I finally got into children's theater and I adored it. 'Little Red Riding Hood' was more my speed than 'Waiting for Godot'."

Judy got a job by proving to a puppet troupe that she could invent convincing voices for inanimate objects. At a puppeteers' convention in Miami she found herself seated with Bob. Some months later they were married and settled in a Greenwich Village brownstone apartment—broke but happy.

Bob, son of a German baker, had a brush with puppetry in fourth grade, when he was given an art project to build a puppet. It turned out pretty well, but he hated having "to make a doll."

Later, he became fascinated, began to make his own puppets and sets and was offered his first performance fee of five dollars at the age of 12. By the time he was 23, he had joined Bil Baird's famous puppet troupe and spent six months touring on a State Department-sponsored trip to the Far East.

In business as a married couple, Bob and Judy managed to rent a small basement room in their building as a workshop. But they found out quickly that they couldn't make a living doing what most puppeteers do—perform in schools.

"To keep going, we made hand puppets," Bob says. "Our first big order was from F.A.O. Schwartz, the famous New York toy store, for 12 dozen of them. We'll never forget that experience. We were watching a TV show about Italian immigrants making paper flowers at the turn of the century. And here we were 60 years later, sewing and glueing together 144 puppets for $2 each!"

"One day a woman called us from Boston representing a hotel chain," Judy says. "She wanted 200 marionettes for restaurant decor and asked us if we had a big studio. We said yes, of course. Then she said she was flying down to see it. We stripped our apartment and put everything in a friend's house. When she arrived, we really did have a big studio. She was particularly impressed with the wall-to-wall carpeting. But then we hired a lawyer to draw up a contract. It was so meticulous that it frightened the hotel people and they turned us down."

Meryle Secrest is a writer for the 'Style' section of the Washington Post.

The Browns bought the largest ad they could afford in the New York Yellow Pages on the theory that strangers who knew nothing about puppet making would assume they were the biggest. By the time the offer came from the Smithsonian, they had built up a profitable business for TV.

Bob's puppets have a distinctive style. The characters are boldly stated with almost always a hint of the lovable buffoon. Eyebrows go up and down as a character snores; bosoms heave violently; moustaches made of Judy's knitting wool flourish; startlingly large feet protrude from a dress.

Most puppets are jointed wood and take weeks to make. Bob has evolved a method for making one in a day. Beginning with a Styrofoam base, he stretches felt over the form of the head, and builds its features from there. The bodies and limbs of felt stuffed with polyethylene are curly and cuddly, like the bodies of small children. The Browns never know just which way the hands and legs will flop.

Bob Brown and Bob Payne design and make all the puppets, sets and costumes. Judy provides scripts and sight gags: "I write the script in pantomime first. Then I add the dialogue and try to keep it to a minimum. Most puppet shows are too talky."

Both Browns have a child's spontaneity and directness. They constantly tell anecdotes—the day one of them got sick or the tape stuck or the front row laughed in the wrong places. They also make thoughtful assessments of audience, material and the art of puppetry itself.

Strangers to suburbia

Their spare time is spent with Michael, their four-year-old son, in their house in Alexandria, Virginia.

Bob says, "We didn't know anything about the out-of-doors. Last fall I used to watch my neighbors rushing out to catch a leaf each time one fell and I used to wonder why they were doing that. Then I found out. We still haven't cleared the yard of leaves."

Do the puppets become real personalities for them? Judy gives an are-you-all-there look. "Don't start that," says Bob. "As soon as the performance is over, I just slap them in a box. The day I start talking to puppets, I'll know I'm in real trouble."

They are clearing up the set after a performance. They turn off the lights, fold the scenery away and begin untangling the wolf's strings. A little girl wanders into the theater from the exhibits area. As she sees the puppets, an expression of delight crosses her face. As if in a trance, she walks to the front row and settles there comfortably without a word, her face turned to the stage. She is waiting, as long as it will take, for the Browns to begin again.

Bob Brown twitches the eyebrows of a clown, one of the stars of his puppet company.

Judy and Bob Brown peer out,
surrounded by characters
from cast of 'Peter and the Wolf'

Highlights

Smithsonian study tours

Two more study tours, offered exclusively to members of the Smithsonian Associates, are:

Canadian Arctic, August 21-30, 1970.

A visit to an Eskimo summer settlement near George River, Ungava Bay, with a stop in Central Labrador. The tour will emphasize the natural history of the Arctic tundra zone, above tree line, and the sub-Arctic forest zone and offers superb fishing. William W. Warner, assistant secretary of the Smithsonian, will conduct the tour.

The Lewis and Clark Expedition, August 22-September 13, 1970.

A tour that closely parallels the route of Lewis and Clark in 1804-1805. It departs from St. Louis and covers 4,000 miles in 23 days via plane, train, bus and river flatboat, ending in Portland, Oregon. James Seymore, research assistant to the director of the National Museum of History and Technology, will conduct.

For more information, write to the Smithsonian Associates Reception Center which is now open in the Great Hall of the Smithsonian Building. It also assists Associates on their visits to the museum.

June events

Arts and Industries Building: On continuous display is the one-pound piece of Apollo 11 moon rock. "Printing Transforms the World: Johann Gutenberg 1400-1468" shows examples of the books that the invention of the printing press made possible. A costumed printer will demonstrate in a reproduction of a printing shop of the period. "Paintings from the U.S. Air Force Art Program" can be seen in the Hall of Aerospace Art.

National Museum of History and Technology: "Women and Politics" follows the history of women in politics from 1640 to the present. Through the use of memorabilia, the show traces the activities of feminists from Abigail Adams to the Women's Liberation, commemorating the 50th anniversary of the 19th Amendment. "Westward to Promontory" is a photographic history of the construction of the transcontinental railroad. The Smithsonian Resident Puppet Theatre (see story on page 58) presents "Peter and the Wolf" through June 14; "Variety" opens June 17.

National Museum of Natural History: A large showing of paintings by Verda and Olmera Peters, "Studies of South African Costume," will be here into July.

National Portrait Gallery: The collection of the Museum of African Art is on display here while its own building is being renovated.

National Collection of Fine Arts: "Leonard Baskin," a mid-career review of one of America's foremost artists, will open June 12. It includes a selection of sculptures, paintings, drawings and book designs.

Traveling Exhibition Service: Some of the Smithsonian exhibits that will appear throughout the country during June are: Detroit, Michigan—"Henry O. Tanner Paintings" (Detroit Institute of Art, June 20 to August 30); Kansas City, Missouri—"Armand Hammer Collection" (William Rockhill Nelson Gallery of Art, June 27 to August 2); Johnson City, Tennessee — "Contemporary American Black Artists" (East Tennessee State University, Carroll Reese Museum, June 20 to July 19); Long Beach, California—"Plastic as Plastic" (California State College, June 14 to July 13); Washington, D.C.—"The Concerned Photographer" (The Federal Deposit Insurance Corporation, June 6 to July 5).

Cooper-Hewitt Museum of Decorative Arts and Design in New York City: The first exhaustive exhibition of 17th- and 18th-century "India Chintz" will be given its only United States showing from June 26 to August 6.

Smithsonian Museum Shops: "Accorsi's Oom Pah Pah Circus," a toymaker's display of circus life, is at the Arts and Industries Building through June; and "American Indian Crafts," traditional and contemporary craft work by a number of Indian tribes, will open June 24 at the Museum of History and Technology.

Division of Performing Arts: The Smithsonian's fourth "Festival of American Folklife" will be celebrated on the Mall from July 1-5, featuring performances and exhibits daily and concerts at night; the theme this year is the state of Arkansas. The Sea Island Singers, pictured below on a 1968 visit, will perform again.

SPECIAL BOOK FEATURE FOR SMITHSONIAN ASSOCIATES

Smithsonian Institution Press

for June . . .

This New Man:

A Discourse in Portraits

edited by J. Benjamin Townsend
with an essay by Oscar Handlin

"What then is the American, this new man?" asked Jean de Crèvecoeur in *Letters from an American Farmer* (1782).

Reproductions of portraits and photographs of 161 Americans —three in color—with accompanying biographical sketches suggest answers to this intriguing question.

Some featured personalities:

Mark Twain
Jean Harlow
Brigham Young
Alexander Hamilton
Dorothea Dix
Buffalo Bill Cody
Fiorello LaGuardia
Robert E. Lee
Sam Houston
Clara Barton

This New Man, originally published for the National Portrait Gallery at $12.50 and $6.95, is now offered at 20% special discount to National Smithsonian Associates. Member's price:

Cloth edition **$10.00**
Paper edition **$ 5.50**

Clip coupon or send order, with payment, to:
Publications Distribution
Smithsonian Institution Press
1242 24th St., N. W. Washington, D. C. 20037

I enclose $____ for ____ copies of **This New Man: A Discourse in Portraits** at $5.50 or $10.00 each. (Sorry we cannot bill you; please include check or money order.)

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Book reviews

Reviewer Michael Bandler suggests some of the best recent books about our environmental crisis

Terracide by Ron M. Linton (Little, Brown, $7.95) is a fascinating volume for the ecological library. Linton, a veteran environmentalist and former government official in that sphere, hammers away relentlessly at the gross carelessness of the American people with regard to the quality of their existence. He opens with a prologue that suggests what life may be like in the future if we are not careful and closes with a hint of the environmental Utopias we can achieve. In essence, his thesis is a modification of the view of a noted Canadian ecologist that man has heedlessly contributed to degradation of his environment and that he must in the future use sensitivity and enlightenment to avoid unnecessary illness and death.

Terracide (the act of destroying the earth) is a veritable gold mine of case studies and statistics that illustrate again and again the extent of the problem. Who would have suspected a few years ago, for instance, that Denver, Tucson and the twin cities of Lewiston and Clarkston on the Clearwater River would face the hazards of air pollution? Mr. Linton cites incidents of odor, noise and food pollution, as well as the dangers of thermal pollution and those inherent in the new technology. Indeed, we now seem to be acclimating ourselves to the problems. Secretary Finch has concluded that unavoidable carcinogens (substances inciting cancerous growth) are so widespread that we cannot eliminate all traces of them and still maintain an adequate food supply.

Having witnessed the extent of federal concern from within, Mr. Linton is not fooled by the comparatively meager funding currently allotted for an environmental protection system "to provide the means of continuously identifying, analyzing and controlling environmental hazards, both old and new, and making certain that environmental protection efforts are comprehensively integrated." Surveillance, development of performance criteria, research and compliance comprise the essence of such a system. In the end, of course, this thoughtful scheme depends upon individuals in public and private sectors —as does our environment.

In *The Conservation Fraud* by Charles Zurhorst (Cowles, $4.95) we meet scorn for those who revere the "good old days" without mentioning epidemics, short-life expectancy and Indians. Mr. Zurhorst, who has served oil, chemical and manufacturing interests, has no love whatever for the numerous conservation organizations that have proliferated of late, and he focuses upon their intergroup squabbles. He resents the tendency of many to place Russell Train—a former tax judge—on the pedestal of "new conservationism" and looks askance at Train's role in The Conservation Foundation and Department of the Interior. Mr. Zurhorst should keep in mind, of course, that some do regard Train as being enlightened and impressive; President Nixon recently shifted him from the second spot in Interior to the chairmanship of the Council on Environmental Quality.

Setting aside the author's prejudices, however, there is merit in many of the views in *The Conservation Fraud*. He blasts Congress' timidity in laying groundwork for a battle against pollution. (The President's February 10 message on the environment also represents a slight change.) He complains about "modern campers" who prefer to take their comforts with them into the woods, rather than roughing it. And he outlines the key hope for salvation—through environmental litigation, based on the Ninth and 14th Amendments—that would uphold individuals' rights to clean air and water and a substantially improved quality of life.

The Diligent Destroyers by George Laycock (Doubleday, $5.95) recounts the many deleterious projects embarked upon by government engineers in the

name of progress, with the blessings of Congressmen seeking political gain. The author suggests an answer. It lies in cutting the budget of the Corps of Engineers, in providing an automatic expiration date for congressional authorization of a water-management project, and in offering detailed planning not only of a proposed public work, but also of alternate plans.

Now that his thoughtful book has been published, Mr. Laycock can only note in his files the remarks of the chief of the Corps of Engineers in early April at the group's first general press conference in its 168 years. Promising that the corps will henceforth consider "the broader public interest," rather than the narrower view of state and local officials, Lieutenant General Frederick J. Clarke noted that he "would like to get into a position where we wear the white hats for a change rather than the black hats."

Our Precarious Habitat by Melvin A. Benarde (Norton, $6.95) declines to view the current crisis in terms of "gloom and doom." This, the most technical of the books mentioned here, stresses that environment is a "vast complex incapable of being grasped by understanding any one of its parts."

Dr. Benarde says our habitat's precariousness emanates from the four p's: population, prosperity, politicians and prices. Each of these, however, can be used to move our environment back from the edge of the precipice. Parents can assist, he adds—concurring in the goal of Earth Day before the fact—by encouraging their sons and daughters to pursue careers in public health or the environmental sciences. Finally, the Philadelphia-based professor of medicine asserts: "It is not necessary to flee from each environmental factor that may be seen as a threat. Our health, so much more precious as lifespan and leisure markedly increase, is not so fragile." One takes a small measure of comfort from Dr. Benarde's reassurances.

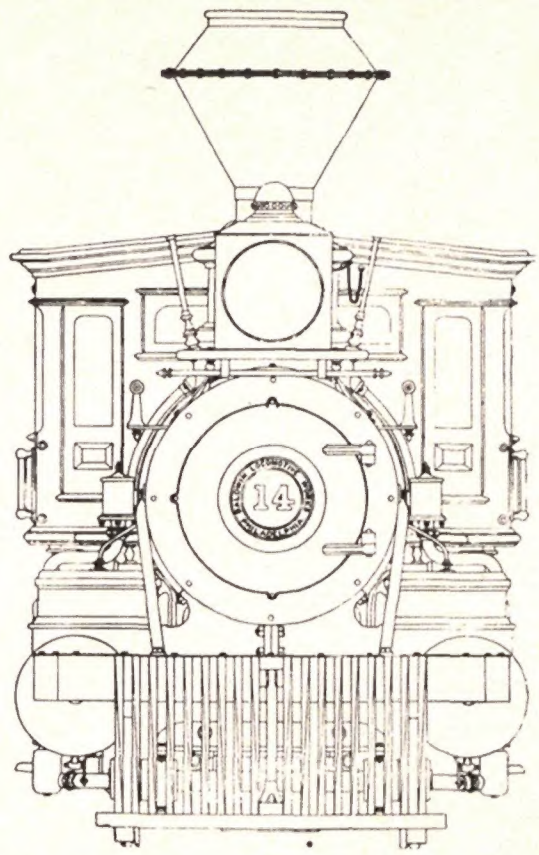
Lost Heritage by Henry Savage jr. (Morrow, $10.00) establishes ties with seven ecologists of 17th- and 18th-century America. Recalling that era of deep concern for the wilderness, he contrasts "an undespoiled America with what we have today." Harking back to the Bartrams, the Michaux (father and son) and other gifted early American naturalists, he pleads for ecological understanding—the same consideration these gentlemen expressed years ago. This, Savage maintains, can only be achieved through "A massive, sustained educational program to inculcate in all human beings everywhere a high degree of ecological wisdom," and a global dissemination of ecological principles "so thorough that man's sense of oneness with nature will be not only common knowledge but an emotional faith deep in the bones of every individual."

When thousands of high schools and universities joined April 22 for programs of environmental education (article on page 14), their students began to understand and experience this faith. The rewards, it is hoped, will be reaped in an enlightened and responsible electorate.

The environmental teach-in a few weeks ago spurred three publishers to issue paperback anthologies of essays by representative ecologists, *The Environmental Handbook* edited by Garrett DeBell (Ballantine / Friends of the Earth Book, 95 cents) and *Ecotactics: The Sierra Club Handbook for Environmental Activists* (Pocket Books, 95 cents) are similar in content. Both encourage young people to eco-activism in the events of April 22 and thereafter. *The Environmental Crisis* edited by Harold W. Helfrich jr. (Yale University Press, $1.95) is a collection of lectures that comprised a 1968-69 symposium on issues in environmental crises at the Yale University School of Forestry. The symposium's success earned it a return engagement—in expanded form—during the current academic year, under the guidance of a visiting professor of environmental humanism at Yale, Stewart L. Udall.

As public and private concern continues to mount, one recalls the words of former Secretary of the Interior Udall, a man who grew more concerned about the environment as his tenure progressed: "Each generation has only a temporary rendezvous with the land; despite fee titles and documents of ownership we are no more than brief tenants on this planet."

sights & sounds



For locomotive enthusiasts of all ages; The "Sounds of 1401", the 33 1/3 rpm record played in the Smithsonian Institution's Railroad Hall. The sounds are those of actual locomotives; tooting whistles, hissing steam and the now extinct chugging of a hard-working engine on a steep grade.
$1.50

For serious students of the history and construction of locomotives; "American Locomotives", by John H. White. This authoritative, technical treatise covers the engineering history of locomotives from the "squat little boiler on wheels" of the 1830's to the "streamlined" Baldwin Ten Wheeler of the 1870's. 500 pages with 235 illustrations.
$20.

Special National Associates discount applies for both the record and the history.

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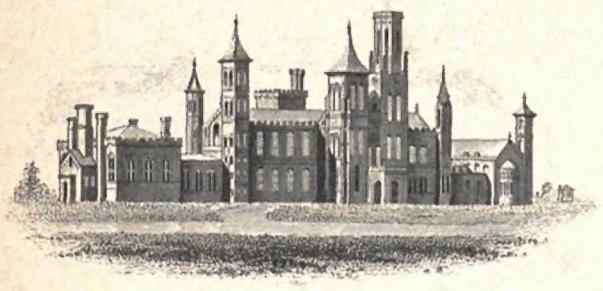
The view from the castle



Our idea for the National Associates of the Smithsonian was almost born in the days of Calvin Coolidge

The idea of establishing the Smithsonian Associates should probably be credited to the fourth Secretary of the Institution, Charles D. Walcott. In 1926 he proposed the creation of a society "to befriend the Institution," but he died too soon to carry his farsighted proposal into effect.

A distinguished geologist, Walcott helped found the Carnegie Institution of Washington. He served as president of the National Academy of Sciences, was chairman of the National Advisory Committee for Aeronautics (ancestor of today's NASA) and a founder of the National Research Council.

He helped to organize a national citizens' committee in 1919, to raise money for portraits of Versailles Peace Treaty figures for the national art collections. This was one of the "seeds" from which grew our National Portrait Gallery. Walcott was also a friend of Charles Freer and instrumental in bringing the Freer collection to the Smithsonian.

Before the unexpected death of this Renaissance man the Regents agreed to set up a Special Committee to seek general endowment funds. It included Dwight Morrow, later to become the father-in-law of a then little-known airmail pilot named Charles Lindbergh. Four months after this meeting, Lindbergh would appear at the Smithsonian to receive its Langley Medal.

The fund drive was kicked off with a conference in which the contributions of the Smithsonian in research were presented, and the urgent need for increased endowment described. Sadly, Walcott had died just two days before the conference was held, in February 1927. But as an earnest of his concern, he left to the Institution a considerable sum of money.

In 1927 congressional appropriations to the Smithsonian had grown to 63 percent of its small budget. Federal support has since grown faster than income from endowment funds, but as a private establishment we have had more research contracts, both government and private. In 1969 our support was about 68 percent federal, 25 percent grants and contracts and only 7 percent endowment funds and gifts.

The 1927 Special Committee reported that Joseph Henry's conception of the Smithsonian as solely a research organization was outdated beyond recall. "We cannot divest ourselves of our duties as a caretaker of these immense collections which have already fallen into our lap, or which will continue to come to us in spite of anything we can do," said the committee.

The increased appropriations for "caretaking and museum activities" put pressure on small private research funds. To help bolster them, the special committee urged the Smithsonian to stop hiding its light under a bushel. It proposed that the Institution emulate the universities by driving hard for "a central endowment, unallocated as to its specific use." Like any major college president, the Secretary should have an appropriate staff. Public meetings should promote the Smithsonian cause and raise millions for endowments.

The "society of friends" that Secretary Charles Walcott wanted might have been the answer to the fund-raising problem. Only in 1965 did the Regents approve the proposal of Senator Leverett Saltonstall and John Nicholas Brown to create our National Associates. Thus Walcott's dream became reality.

S. Dillon Ripley

"Prominent citizens" forgathered in February 1927, in Great Hall of Smithsonian's castle to hear the report of a Special Committee on increasing the Institution's private funds. Here sit 1) Andrew Mellon, Secretary of the Treasury, 2) Frank Kellogg, Secretary of State, 3) President Calvin Coolidge, 4) Chief Justice William Howard Taft, 5) Charles G. Abbot, then Acting Secretary of the Smithsonian, 6) Senator Reed Smoot of Utah, 7) William Jardine, Secretary of Agriculture, 8) Herbert Hoover, Secretary of Commerce, 9) James J. Davis, Secretary of Labor, and 10) Dwight Morrow, then of J. P. Morgan and Co. Towering in the rear center is a column of Smithsonian publications.

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